ANNALS OF CARNEGIE MUSEUM
VOL. 68, NUMBER 2, PP. 91–149 14 MAY 1999

TOURNAISIAN (EARLY OSAGEAN) BRACHIOPODS FROM A BIOHERM IN THE ST. JOE FORMATION NEAR KENWOOD, OKLAHOMA

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ABSTRACT

A diverse early Osagean (Upper Tournaisian) brachiopod fauna from a carbonate buildup in the St. Joe Formation near Kenwood, Mayes County, northeastern Oklahoma, is described. This is the earliest Lower Carboniferous, and perhaps only, Tournaisian biohermal brachiopod fauna described in North America, although potentially earlier unknown faunas could occur in mid-Kinderhookian bioherms of southwestern Missouri. It consists of 40 species in 34 genera and is characterized by unusually robust specimens of several species. New species are *Geniculifera siphuncula, Pustula kenwoodensis, Pustula oklahomae, Schizophoria mayesensis, Rhynchopora kollari, Cranaena salinensis,* and *Dielasma oklahomensis.*

KEY WORDS: brachiopods, Tournaisian, Osagean, bioherm, St. Joe Formation, Oklahoma, Mississippian, Lower Carboniferous

INTRODUCTION

Lower Carboniferous North American brachiopod faunas from either bioherms or framework-supported reefs have never been described and illustrated. This report consists of the description of such a fauna from the unbedded biosparite core, not flanking beds, of a biohermal mound in northeastern Oklahoma.

The term bioherm is used here in the sense of Wilson (1975:23), that is, a "buildup whose internal composition shows it to be largely derived from in situ production of organisms or as framework or encrusting growth as opposed to mainly mechanical (hydrodynamical) piling." Wilson further characterized Waulsortian mounds as being composed of massive lime mudstones with scattered crinoidal and bryozoan fragments which form lenslike buildups or mounds.

After the end of the great Frasnian extinction event true reefs were absent from the world's oceans for a considerable period of time. Although organic framework-supported reefs possibly did not reappear until the Viséan, carbonate buildups started appearing in North America along the margins of the Burlington Shelf of Lane (1978) during the Tournaisian (late Kinderhookian and early Osagean) as bioherms and Waulsortian mounds. The former generally have a thick, crinoidal, nonbedded inner core and the latter have a fine-grained micritic core. The earliest known North American buildups are in the late Kinderhookian Compton Limestone of southwestern Missouri (Thompson and Fellows, 1970). According to Lane (1982) the basal beds of the Swimming Woman Canyon carbonate mound in central Montana, as described by Cotter (1965), bear late Kinderhookian conodonts.

Lower Carboniferous bioherms and other carbonate buildups have been described in the Tri-State District (Missouri, Oklahoma, and Kansas) mining area from the St. Joe and Keokuk formations of northeastern Oklahoma by Harbaugh (1957), from the St. Joe Formation of southwest Misssouri and northwest Arkan-

Submitted 19 March 1998.

sas by Troell (1962), from the Reeds Spring Formation of northeastern Oklahoma by McKnight and Fischer (1970), and from the Compton Limestone of southwestern Missouri by Thompson and Fellows (1970). Lane (1982) summarizes the distribution of early Carboniferous carbonate buildups in North America, which he terms the "Waulsortian facies."

Brachiopods or other macrofossils have been rarely reported or described from carbonate buildups in the early Carboniferous. Demanet (1923) described the Early Viséan faunas from the flank beds of the Waulsortian mounds near Sosoye, Belgium. Gordon, in McKnight and Fischer (1970), listed fossils, mostly brachiopods, from a bioherm in the Reeds Spring Formation of northeast Oklahoma. Mundy and Brunton (1985) and Brunton and Mundy (1988) described diverse brachiopod faunas from Upper Viséan reefs in England. An undescribed brachiopod fauna of late Kinderhookian or early Osagean age was collected by Glenister and his students (personal communication) from a thick buildup in the Lodgepole Formation of Montana, as described by Cotter (1965).

The general features of the carbonate buildup that is the subject of this report were described by Harbaugh (1957). The massive nonbedded core facies described and illustrated by Harbaugh (1957) from the west end of the Kenwood bioherm was subsequently penetrated by a small quarry, which yielded the exceptionally well-preserved fauna described below. About six to eight meters of limestone are exposed in the quarry, all in the core facies. Presumably, the floor is normal bedded limestone but it is cluttered with debris and large blocks from the quarrying operation and examination of the floor is difficult.

In the Folk (1962) classification scheme the limestone of virtually the entire core would be termed a fine to coarse biosparite. Virtually no micrite was observed in numerous hand samples. There is no indication of stratification of the core. Vugs occur sparsely throughout the core, although being most numerous near large biogenic clasts. Brachiopods, rare bivalves, and very rare corals are the largest clasts observed although occasional crinoid plates and columnals were found intact. Fossils are sparsely and irregularly distributed throughout the core facies in this small quarry.

The paleoecological setting for this assemblage is unknown and undescribed in the literature. Lane (1982) interpreted the carbonate buildups of Osagean age in the Kenwood region as being formed at the outer shelf edge, presumably on the slope and in water of moderate depth. The excellent preservation, with no signs of abrasion from transport, suggests that the fossils were found more or less in situ. If that is indeed the case then one could conclude that the brachiopods and other large faunal elements were buried by rapidly accumulating crinoid debris in a thriving crinoid thicket. The water must have been of sufficient depth to prevent comminution of the crinoid plates, ossicles, and other clasts that make up the biogenic portion of the biosparite.

Orientation of specimens appears to have been random although geopetal accumulations of carbonate sand in the ventral umbonal regions of several of the spiriferoid brachiopods were noted. The interiors of most of the complete specimens are completely or partially filled with calcite spar. Wilson (1975:146) warned against interpreting sparry in-fillings as an indicator of high-energy environments.

STRATIGRAPHIC SETTING

The name St. Joe was first used by Hopkins (1893) for extensive exposures at St. Joe, Searcy County, Arkansas, wherein he designated it as the basal unit of

the Boone Formation. Cline (1934) raised the St. Joe of Oklahoma to formational rank and Clarke and Beveridge (1952) raised the St. Joe of Missouri to group rank, including the Compton Limestone, Northview Formation, and the Pierson Formation, in ascending order.

In northeastern Oklahoma, according to Huffman (1958), the St. Joe Formation generally consists of about ten feet of thin-bedded, gray nodular limestone at the base, a middle portion composed of several feet of soft, limy green shale, and an upper portion of about 25 feet of gray, thick-bedded, coarse-grained crinoidal limestone. It rests unconformably on the Chattanooga Shale which is absent in some areas and is conformably overlain by the Reeds Spring Limestone (Moore, 1928). McKnight and Fischer (1970) reassigned the St. Joe of northeastern Oklahoma to the Boone Formation and reduced it to member level. However, most recently Fay (1987) used the term St. Joe Group in the COSUNA correlation chart for this region. Following Thompson and Fellows (1970), the St. Joe is referred to in the present report as a formation. The bioherm that is the subject of this paper occurs within the upper unit, which is coeval with the upper St. Joe at its type section in Arkansas and the Pierson Formation of southwestern Missouri.

BIOSTRATIGRAPHY

This Kenwood fauna is clearly of early Osagean age and can be correlated readily with similar faunas from the upper St. Joe Formation of northcentral Arkansas, the Pierson Formation of southwestern Missouri, the lower Burlington Limestone of eastern Missouri, and the Fern Glen Formation of eastern Missouri and western Illinois.

Girty (1915) described or discussed a total of 39 species of invertebrates collected from the upper beds of the St. Joe at or near its type section near St. Joe, Searcy County, Arkansas. This included six corals, nine bryozoans, 23 brachiopods, and one gastropod. Following Weller (1909) he correlated this fauna with that of the Fern Glen Formation of eastern Missouri, a general correlation that stands today. Neither Weller (1909) nor Girty (1915) collected faunas from the basal beds of the St. Joe which were not exposed at that time. A subsequent quarrying operation revealed the lower St. Joe. By digging a trench at this locality I have recovered the following fauna from thin limestone beds one to two feet above the base of the St. Joe:

Leptagonia sp.
"*Chonetes*" sp.
Productina sampsoni (Weller, 1909)
Magnumbonella newarkensis (Moore, 1928)
Magnumbonella sp.
"*Avonia*" *honeycreekensis* Carter, 1967
Rhytiophora blairi (Miller, 1881)
Rhipidomella sp.
Macropotamorhynchus tuta (Miller, 1881)
Macropotamorhynchus chouteauensis (Weller, 1914)
Shumardella obsolescens Weller, 1910
Cleiothyridina n. sp.
Crurithyris parva (Weller, 1899)
Prospira latior (Swallow, 1863)

Voiseyella sp.
Brachythyris sp.
Cyrtina sp.
Cranaena sp.

This fauna is indicative of a late Kinderhookian age, which is in agreement with the conodonts recovered at this locality by Thompson and Fellows (1970).

In addition to the fauna reported by Girty (1915) from the upper St. Joe at the type section, I found at this same locality specimens of *Marginatia fernglenensis* (Weller, 1909), *Eomartiniopsis rostrata* (Girty, 1899), *Crinisarina prouti* (Swallow, 1860), and *Fernglenia vernonensis* (Swallow, 1860). These occurrences further confirm the correlations discussed above.

Huffman (1958), in summarizing the paleontology of the St. Joe of northeastern Oklahoma, listed the following ten brachiopod species:

Rhipidomella oweni Hall and Clarke
"*Dictyoclostus*" *fernglenensis* (Weller)
Spirifer rowleyi Weller
Spirifer vernonensis Swallow
Brachythyris suborbicularis (Hall)
Athyris lamellosa (Léveillé)
Cliothyridina prouti (Swallow)
Pseudosyrinx missouriensis Weller
Allorhynchus sp.
Leptaenella analoga (Phillips)

It is evident from this list that these collections were made from the upper, early Osagean portion of the St. Joe.

The Kenwood, Oklahoma, Locality

A large collection of well-preserved brachiopods was made in a small, abandoned quarry in a massive biohermal core on the north side of the Salina–Kenwood Road, about two miles west of Kenwood, Mayes County, Oklahoma (SE ¼, SE ¼, Sec. 11, T 21 N, R 21 E). The database number of this collection is SL407. There is another sizable collection of this material in the National Museum of Natural History, made by G. A. Cooper in the 1960s.

Faunal Composition

Most Lower Carboniferous articulate brachiopod groups are represented in this fauna. Inarticulates are conspicuously absent. All major groups are represented by at least two genera except for the impunctate rhynchonellids with only one genus, *Macropotamorhynchus* Sartenaer. Table 1 shows the occurrences of the Kenwood brachiopod species in the Pierson Formation of southwestern Missouri, the upper St. Joe at its type section in Arkansas, the Lower Burlington Limestone of eastern Missouri, and the Fern Glen Formation of eastern Missouri.

This fauna is notable for the unusually large specimens of several species, including *Leptagonia analoga* (Phillips), *Pustula kenwoodensis* n. sp., *Lamellosathyris lamellosa* (Léveillé), *Eomartiniopsis* n. sp., *Brachythyris chouteauensis* (Weller), ?*Torynifer* sp., *Cranaena globosa* Weller, *Cranaena salinensis* n. sp., and *Dielasma oklahomensis* n. sp. In addition, several other large species are a

Table 1.—*Occurrences of Kenwood brachiopod species also found in the Pierson Formation of southwestern Missouri, the upper St. Joe Formation in northcentral Arkansas, the lower Burlington Limestone in eastern Missouri, and the Fern Glen Formation in eastern Missouri. New and indeterminate Kenwood species are not included.*

Species	Kenwood Loc.	Pierson Fm.	St. Joe of Ark	L. Burl. Ls.	Ferm Glen Fm.
Leptagonia analoga	X	X	X	X	X
Rugosochonetes multicostus	X	X	X	X	X
Caenanoplia burlingtonenesis	X	X		X	X
Breileenia minnewankensis	X			X	
S. (Seminucella) semicostata	X			X	
Marginatia magna	X			X	
Scutepustula arctifossa	X	X		X	
Ovatia laevicosta	X	X	X	X	
Rhipidomella diminutiva	X	X	X	X	X
Macropotamorhynchus tuta	X			X	
Rhynchopora persinuata	X	X		X	X
Coledium simulans	X		X		
Rowleyella fabulites	X			X	
Lamellosathyris lamellosa	X	X	X	X	X
Crinisarina prouti	X	X	X		X
Cleiothyridina cf. *glenparkensis*	X	X		X	X
Eomartiniopsis rostrata	X		X		
S. (Mesochorispira grimesi	X	X	X	X	
Fernglenia vernonensis	X	X	X		X
Tegulocrea incerta	X			X	
Voiseyella novamexicana	X	X		X	X
Brachythyris chouteauensis	X	X	X	X	X
Kitakamithyris cooperensis	X	X	X	X	
Pseudosyrinx missouriensis	X	X	X	X	
Punctospirifer subtexta	X	X		X	X
Cranaena globosa	X			X	

conspicuous constituent of this fauna, including *Marginatia magna* Carter and *Spirifer* (*Mesochorispira*) *grimesi* (Hall).

Although Girty (1915) listed 23 brachiopod species in the St. Joe at the type section many of his identifications were queried or indeterminate and a much less diverse fauna is the norm for the St. Joe Formation. Huffman (1958) reported only ten species in the normally bedded St. Joe of northeastern Oklahoma, as compiled from the literature, and Gordon (in McKnight and Fischer, 1970) identified 12 species from six collections. This contrasts sharply with the 40 species identified in this report from a single collection.

Mundy and Brunton (1985) and Brunton and Mundy (1988) documented more than 45 genera of brachiopods in the Upper Viséan (mostly Asbian) reefs of the Craven Reef Belt in England. At least some of these reefs were partially framework-supported.

Although not the most numerous elements of their faunas, strophalosioids and aulostegoids formed an important epifaunal constituent, as in the Permian reefs of West Texas described by Grant (1971). Neither of these groups are present in the Kenwood St. Joe fauna which seemingly provided no obvious firm attachment substrate, except for the sparsely distributed coarse skeletal material including other brachiopods. However, there were primitive aulostegoids at about this time in the midcontinent. Carter (1991*b*) described the aulostegoid *Archaiosteges* Carter, 1991, from the upper, early Osagean beds of the Gilmore City Limestone of

northern Iowa. The specimens of this genus were collected from a lagoonal oolite but were clearly transported and their provenance in life is unknown. It is possible that the pedunculate Kenwood brachiopods were attached to living crinoids which buried the brachiopods in coarse debris when they died and disarticulated.

Comparison of the Kenwood fauna with other biohermal faunas of the same age is not possible at the present time due to a dearth of information. However, one can conclude that although the diversity of the Kenwood bioherm is comparable to younger framework-supported reefs the characteristic epifaunal and cemented groups had not yet exploited these early Carboniferous buildups, possibly due to a lack of suitable substrates.

SYSTEMATIC PALEONTOLOGY

In the following treatment generic diagnoses are not provided if they are essentially correct in the "Treatise on Invertebrate Paleontology" or can be found in the recent literature (see Literature Cited). Higher classification generally follows that proposed by Carter et al. (1994), Brunton et al. (1995), Brunton and Cocks (1996), Savage (1996), and Williams et al. (1996). Types and figured specimens are deposited in the Section of Invertebrate Paleontology, Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania.

Phylum Brachiopoda Duméril, 1806
Subphylum Rhynchonelliformea Williams, Carlson, Brunton, Holmer, and Popov, 1996
Class Strophomenata Williams, Carlson, Brunton, Holmer, and Popov, 1996
Order Strophomenida Öpik, 1932
Suborder Strophomenidina Öpik, 1932
Superfamily Strophomenoidea King, 1846
Family Leptaenidae Hall and Clarke, 1894
Genus *Leptagonia* M'Coy, 1844
Leptagonia analoga (Phillips, 1836)
(Fig. 1A–E)

1836 *Producta analoga* Phillips: p. 116, pl. 7, fig. 10.
1968 *Leptagonia analoga* (Phillips): Brunton, pp. 29–31, pl. 3, fig. 26–31, pl. 4, fig. 1–9; textfig. 6–17.
1972 *Leptagonia analoga* (Phillips): Brand, pp. 59–61, pl. 8, fig. 1–6.

Diagnosis.—From Brunton (1968:29): "Subquadrate to semicircular *Leptagonia* with adult disc about one-half as long as wide, outline commonly modified by emargination medianly and less commonly laterally; immature shells planoconvex, adult shells biconvex, about one-half as deep as long, commonly uniplicate, rarely parasulcate; dorsally directed trail variably developed; visceral region with 14–18 regular rugae having mean wavelengths of 1.0 mm and 1.4 mm for the fifth and tenth rugae; rounded costae, commonly 5 or 6 in 2 mm, 10 mm anteromedianly of umbones; pseudospondylium subcircular, seven-tenths as long as wide and about one-third as long as length of disc; dorsal muscle field one-half as long as wide; median septum extending forward for about two-fifths length of disc."

Comments.—This species does not occur above the Upper Tournaisian in North America. The genus *Leptagonia* does not reappear in North America until the end of the Chesterian (late Serpukhovian) where it occurs as undescribed new species in the Imo Formation of Arkansas and the Chainman Shale of Utah.

This species appears to be highly variable in the development of a high ridge at the margin of the ventral disc, maximum depth of the visceral area of the conjoined valves, and development of a pseudospondylium. For example, the specimens considered here from the Kenwood locality are rarely, if ever, half as thick as long. On the other hand, similar specimens from the Nunn Member of the Lake Valley Formation of New Mexico generally are more than half as thick as long but are otherwise closely similar to the Kenwood specimens. The development of a pseudospondylium has not been observed. If it existed in juveniles, as in Brunton's specimens, the existence of this structure awaits description.

The costation density of these Kenwood specimens of 19–21 per 5 mm at a distance of 1 cm anterior to the umbones falls within the range of 15–22 as given by Brand (1972).

Material.—In addition to the illustrated specimens there are seven more or less complete specimens and five disarticulated valves.

Suborder Orthotetidina Waagen, 1884
Superfamily Orthotetoidea Waagen, 1884
Family Schuchertellidae Williams, 1953
Genus *Schuchertella* Girty, 1904
Schuchertella sp.
(Fig. 1F, G)

Comments.—Orthotetoids are rare in this fauna and are invariably disarticulated and generally fragmentary. The only two complete valves are figured here (Fig. 1). Figure 1F is a nearly complete, flat dorsal valve. The umbo is spalled, revealing a very low, bilobed cardinal process and short diverging sockets. The other specimen (Fig. 1G) is a thicker, more-inflated ventral valve which lacks any evidence of internal plates. Thus, there seems to be little doubt about assignment of these specimens to the genus *Schuchertella*, but the paucity of material obviates a species assignment.

Suborder Chonetidina Muir-Wood, 1955
Superfamily Chonetoidea Bronn, 1862
Family Rugosochonetidae Muir-Wood, 1962
Genus *Rugosochonetes* Sokolskaya, 1950
Rugosochonetes multicostus (Winchell, 1863)
(Fig. 1H–J)

1863 *Chonetes multicosta* Winchell: p. 5.

Diagnosis.—Transversely subquadrate *Rugosochonetes* generally with greatest width at hingeline, about two-thirds as long as wide; ventral valve with shallow medial sinus or flattening in anterior two-thirds of valve; hingeline with six or seven fine spines on each side of beak; large specimens with about five capillae per millimeter at medial anterior margin.

Comments.—The specimen selected by Weller (1914:pl. 8, fig. 12, University of Michigan number 1343) as the most typical of Winchell's eight syntypes is hereby designated as the lectotype. This specimen is from the lower Burlington Limestone at Burlington, Iowa, hence from the Dolbee Creek Member. Selection of a lectotype is necessary for the purposes of nomenclatorial stability because the syntype suite includes several species ranging in age from earliest Kinder-

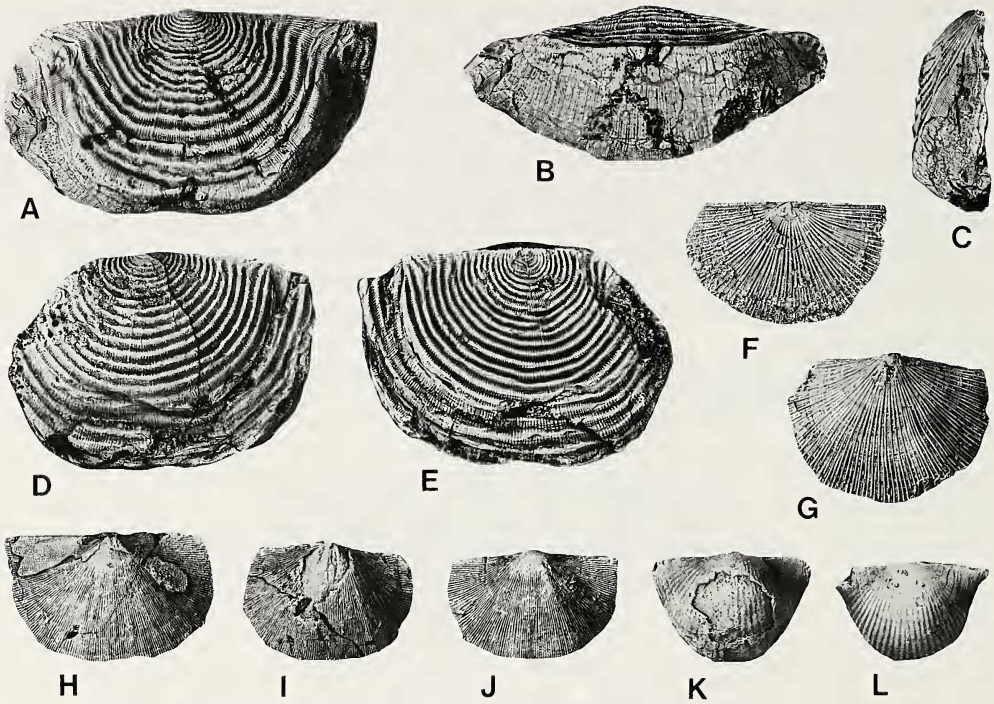

Fig. 1.—Strophomenids and chonetids. A–E, *Leptagonia analoga* (Phillips); A–C, ventral, anterior, and lateral views of large ventral valve, CM 45000; D, E, ventral and dorsal valves of nearly complete specimen, CM 45001, both × 1. F, G, *Schuchertella* sp., ventral and dorsal valves, CM 45002, 45003, both × 1. H–J, *Rugosochonetes multicostus* (Winchell), three ventral valves, CM 45004–45006, all × 2. K, L, *Caenanoplia burlingtonensis* Carter, two ventral valves, CM 45007, 45008, × 2.

hookian through the middle Osagean. *Rugosochonetes multicostus* apparently ranges from the late Kinderhookian into the middle Osagean, but a thorough revision is needed in order to establish this range with confidence.

Material.—In addition to the illustrated specimens there are five ventral valves.

Family Anopliidae Muir-Wood, 1962
Genus *Caenanoplia* Carter, 1968
Caenanoplia burlingtonensis Carter, 1968
(Fig. 1K, L)

1968 *Caenanoplia burlingtonensis* Carter: p. 1144, pl. 145, fig. 1–26.

Diagnosis.—Strongly concavo-convex *Caenanoplia* with large, well-defined subangular auriculations, faintly capillate ornament, coarsely lamellose growth lamellae, and two spines on each side of beak inclined at high angle to hingeline.

Comments.—This species has previously only been reported from the lower Burlington white chert at Louisiana, Missouri. It is most similar to *Retichonetes*? *gibberula* Carter, 1967, from the Chappel Limestone of central Texas. The latter differs in being more transverse, having smaller ears, a less inflated, more poorly differentiated umbonal region, only one spine on each side of the beak, and a shorter ventral septum.

Small specimens of *Caenanoplia logani* (Norwood and Pratten, 1855) are sim-

ilar in outline to *C. burlingtonensis* but the former can be readily differentiated by its smaller ears. Normal adults of this species are much larger than *C. burlingtonensis*.

Material.—In addition to the illustrated specimens there are three ventral valves.

Suborder Productidina Waagen, 1883
Superfamily Productoidea Gray, 1840
Family Productellidae Schuchert, 1929
Subfamily Marginiferinae Stehli, 1954
Tribe Breileeniini Brunton, 1997
Genus *Breileenia* Brunton, 1997
Breileenia minnewankensis (Shimer, 1926)
(Fig. 2A–N)

1926 *Productus minnewankensis* Shimer: p. 40, pl. 1, fig. 6a–c, 7.
1942 *Avonia linospinosa* Sutton: p. 466, pl. 71, fig. 5–7.
1942 *Avonia minuta* Sutton: pp. 466–467, pl. 71, fig. 3, 4.
1987 *Avonia minnewankensis* (Shimer): Carter, p. 31, pl. 6, fig. 1–14.

Diagnosis.—Small, narrow, very strongly concavo-convex, with narrow ventral umbonal region; spine bases elongate, scattered in umbonal region; spine bases forming continuous costellae anterior to umbo and on moderately long trails of both valves; spines arranged roughly concentrically in widely spaced rows anterior to umbonal region.

Comments.—This species is similar to *Breileenia williamsana* (Girty, 1931) from the Keokuk Limestone (early and possibly middle Viséan) and *Avonia batchatica* (Tolmachev, 1924) from the Tournaisian of the Kuznets Basin. *Breileenia williamsana* (Girty) is larger, broader, and has much shorter trails in both valves. *Avonia batchatica* (Tolmachev) is more similar to *B. williamsana*, being larger, with short trails, and in addition, it has weak dorsal ribbing.

Carter (1987) placed the two Burlington Limestone species proposed by Sutton (1942) in synonomy with *B. minnewankensis*, being unable to differentiate them morphologically or biostratigraphically.

Material.—In addition to the illustrated specimens there are 130 specimens, mostly disarticulated ventral valves.

Subfamily Plicatiferinae Muir-Wood and Cooper, 1960
Tribe Levitusiini Muir-Wood and Cooper, 1960
Genus *Geniculifera* Muir-Wood and Cooper, 1960
Geniculifera siphuncula, **new species**
(Fig. 2O–T)

Holotype.—CM 45013, Fig. 2S, 2T, a nearly complete shell with conjoined valves and narrow, nasute elongation.

Paratype.—CM 45012, Fig. 2O–R, a ventral valve.

Diagnosis.—Medium-size *Geniculifera* with short trail in both valves forming narrow, nearly complete, medial anterior siphon.

Description.—Medium size for genus, transversely subquadrate in ventral view; cardinal extremities angular, but maximum width anterior to hingeline; umbonal region not much inflated, ventral visceral disc weakly to moderately convex; trails short, medially extended by narrow nasute constriction; body cavity moderately shallow.

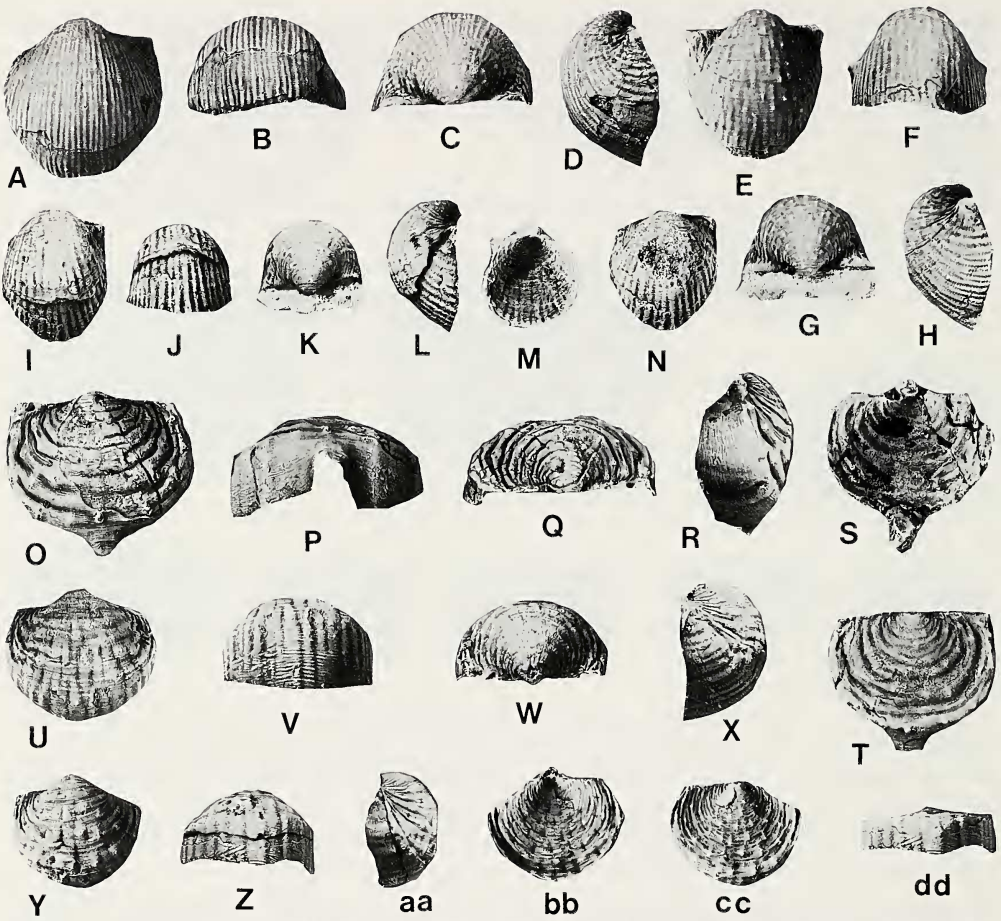

Fig. 2.—Productoids. A–N, *Breileenia minnewankensis* (Shimer); A–H, ventral, anterior, posterior, and lateral views of two ventral valves, CM 45009 and 45010, × 2; I–N, ventral, anterior, posterior, lateral, and dorsal views, and dorsal mold of a complete specimen, CM 45011, × 2. O–T, *Geniculifera siphuncula* n. sp.; O–R, ventral, anterior, posterior, and lateral views of a large ventral valve paratype, CM 45012, × 2; S, T, dorsal valve and dorsal mold of the holotype, a nearly complete specimen, CM 45013, × 2. U–dd, *Spinocarinifera* (*Seminucella*) *semicostata* (Girty); U–X, ventral, anterior, posterior, and lateral views of a large ventral valve, CM 45014; Y–dd, ventral, anterior, lateral, dorsal, dorsal views of dorsal valve mold, and anterior view of same mold, CM 45015, all × 1.5.

Ventral valve weakly convex in umbonal region, strongly geniculated; ears small, well delimited by concave flexures; flanks steep, normal to plane of articulation; anteromedial portion of trail narrowly constricted into anteriorly directed gap; beak small, projecting posteriorly slightly; hinge spines rare, only one or two at most on each side of beak, but with several erect or clasping spines just anterior to hingeline; visceral disc with several, generally 20 or more, widely spaced erect spine bases with single median spine just posterior to siphon on all three ventral valves in this collection; no spines on trail; concentric ornament of several, generally about seven or eight, irregular rugae on visceral disc; radial ornament lacking; interior unknown.

Dorsal valve weakly concave on visceral disc except for convex flexures defining ears; strongly geniculate; protegulal node at hingeline; trail short, with elongate medial extension matching that of opposite valve; ornament complementary to opposite valve with scattered shallow pits more or less opposite ventral spines and rugae on visceral disc; spines absent; interior unknown.

Measurements of Types.—See Table 2.

Table 2.—*Measurements (in mm) of the types of* Geniculifera siphuncula, *n. sp.*

Number	Length	Width	Thickness	Surface measure
CM 45013	11.0	11.2	2.4	13.2
CM 45012	10.9	12.7	—	13.0

Comparisons.—The nearly complete narrow siphon of this new species differentiates it from the other species assigned to the genus *Geniculifera.* The type species, *Avonia boonensis* Branson, 1938, is from the Chouteau Limestone of Missouri. Although the trail of this species is lobate, it lacks the nearly complete siphon seen in this new species. *Geniculifera brevicula* Carter, 1967, from the Chappel Limestone of central Texas, can be differentiated in the same manner.

Comments.—The development of a narrow, nasute elongation on a short trail appears to be the only difference between this St. Joe species and its predecessors. The anterior lobation seen in the earlier two species is a precursor to this distinctive modification.

Material.—Types only.

Family Productidae Gray, 1840
Subfamily Leioproductinae Muir-Wood and Cooper, 1960
Tribe Semiproductini McKellar, 1970
Genus *Spinocarinifera* Roberts, 1971
Subgenus *Seminucella* Carter, 1987
Spinocarinifera (*Seminucella*) *semicostata* (Girty, 1915)
(Fig. 2U–dd)

?1888 *Productus rushvillensis* Herrick: p. 22, pl. 3, fig. 15.
1915 *Productella semicostata* Girty: p. 12, pl. 1, fig. 6–7c.

Diagnosis.—Medium-sized geniculate *Seminucella* with transversely subovate outline in ventral view, coarsely costellate, moderately short trails, and generally convex lateral extremities with few spines.

Comments.—Hyde (1953:234) considered Girty's species *Productella semicostata*, from the St. Joe Formation of Arkansas, to be a subjective synonym of *Productus rushvillensis* Herrick, 1888, from the Rushville Formation of Ohio. The early Osagean age of the St. Joe is well established as is that of the Rushville (Thompson et al., 1971:705). Unfortunately, Herrick's collection of *P. rushvillensis* is long lost, leaving us with only a crude line drawing of the type (Herrick, 1888:pl. 3, fig. 15). Hyde (1953) must have seen specimens of this species in order to be confident of the synonomy of the two taxa but his collections of this species are also lost and he did not illustrate the species. No specimens of *Productus rushvillensis* are known to be extant.

Girty's types from the St. Joe of Arkansas are preserved in the National Museum of Natural History, Washington, D.C. They clearly represent the species found in the St. Joe of the Kenwood bioherm. For these reasons Girty's species name is used here with the full realization that Herrick's name may be valid and have seniority.

This species is generally similar to *Spinocarinifera* (*Seminucella*) *pustulifera* (Moore, 1928) from the lower Burlington Limestone of Missouri. The latter differs in being slightly smaller, more evenly convex in profile, more finely ribbed, and it has more numerous spines on the lateral extremities, sometimes forming a

brush. *Spinocarinifera* (*Seminucella*) *parva* Carter, 1987, from the Banff Formation of Alberta, is much smaller, more elongate, and more finely ribbed with pinched concave lateral extremities generally bearing a brush of fine spines.

Material.—In addition to the illustrated specimens there are 13 other specimens including four with conjoined valves.

Subfamily Buxtoniinae Muir-Wood and Cooper, 1960
Tribe Tolmatchoffiini Sarycheva, 1963
Genus *Marginatia* Muir-Wood and Cooper, 1960
Marginatia magna Carter, 1968
(Fig. 3A–I)

1968 *Marginatia magna* Carter: p. 1147, pl. 147, fig. 1–9.

Diagnosis.—Large elongate *Marginatia* with long, irregularly fluted, sometimes spreading trail and shallow fold and sulcus; internally with large trilobate cardinal process with long, deep antron.

Comments.—This distinctive species is easily differentiated from other species of *Marginatia* by its large size alone. *Marginatia fernglenensis* (Weller) is a widely distributed species found in several formations of slightly greater age than *M. magna*. It differs in being smaller with a weaker fold-sulcus and internally has a very small antron, or lacks one altogether. *Marginatia burlingtonensis* (Hall), of slightly younger age, differs in being smaller, much more finely ribbed, and having a stronger fold-sulcus.

Material.—In addition to the illustrated specimens there are 43 other specimens, including many with conjoined valves.

Superfamily Echinoconchoidea Stehli, 1954
Family Echinoconchidae Stehli, 1954
Subfamily Pustulinae Waterhouse, 1981
Genus *Pustula* Thomas, 1914
Pustula kenwoodensis, **new species**
(Fig. 4A–D, O; 5A–C)

Holotype.—CM 45018, Fig. 4A–D, a large ventral valve.

Paratypes.—CM 450022, Fig. 4O, natural mold of a dorsal exterior; CM 45023, Fig. 5A–C, a large ventral valve.

Diagnosis.—Large, transverse, strongly inflated *Pustula* with shallow, wide, rounded fold and sulcus, strongly rugose visceral region, and flared marginal rim.

Description.—Large for genus, ventral valve strongly convex, transversely subquadrate to transversely subovate in outline; greatest width generally near midlength (excluding marginal rim); ears small, subangular, well delimited by strongly concave flexures; body cavity deep.

Ventral valve strongly convex in lateral profile, generally not geniculate, most convex in umbonal region; lateral slopes dropping steeply to lateral margins; sulcus broad, shallow, wide, originating just anterior to umbonal region as flattened venter and becoming rounded and deeper anteriorly; anterior profile subtrapezoidal to subquadrate; umbonal region moderately broad, posteriorly overhanging

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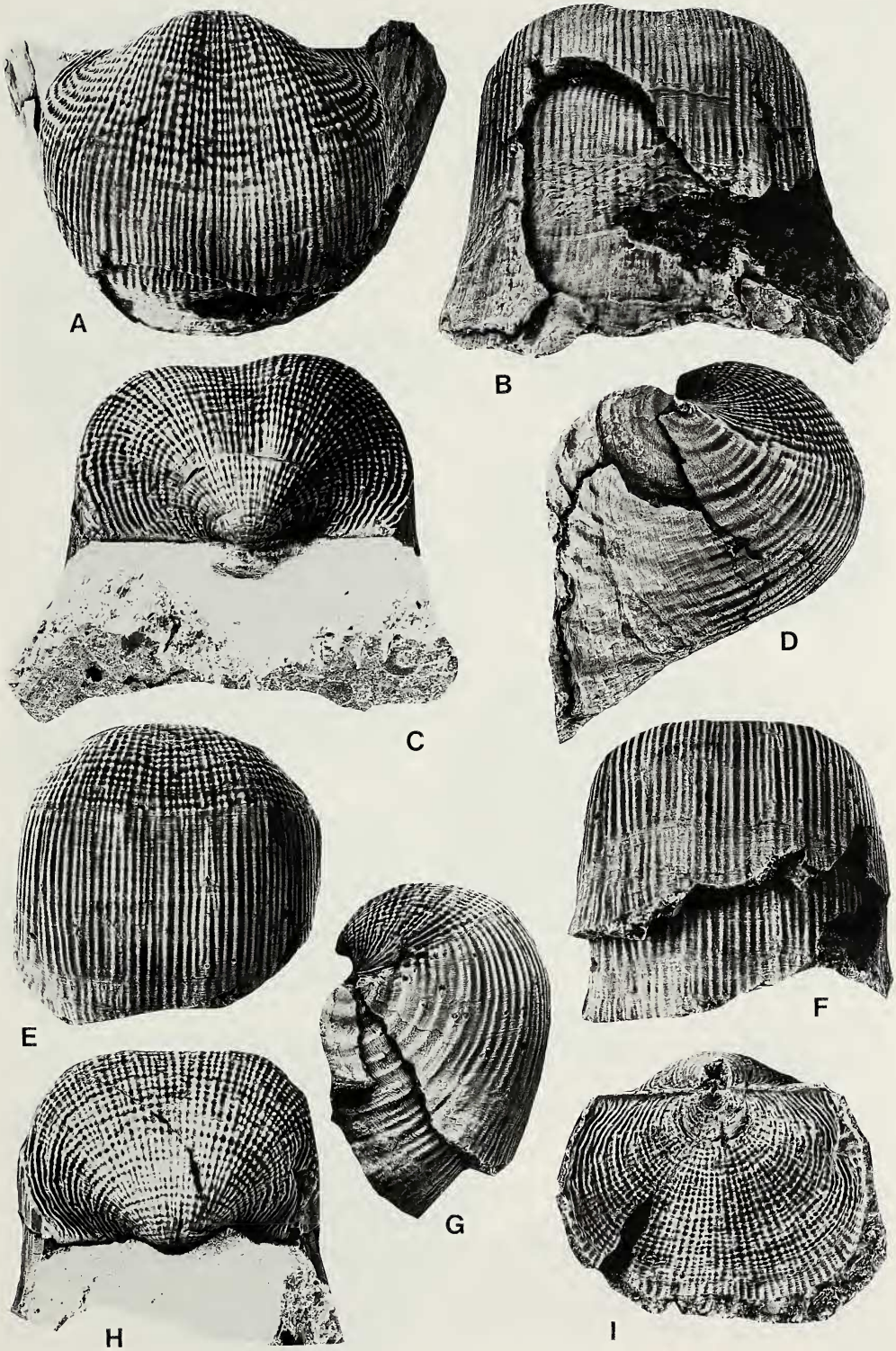
Fig. 3.—Productoids. *Marginatia magna* Carter; A–D, ventral, anterior, posterior, and lateral views of a very large specimen showing the anterior spreading of the trail, CM 45016; E–I, ventral, anterior, lateral, posterior, and dorsal views of a nearly complete shell, CM 45017; all × 1.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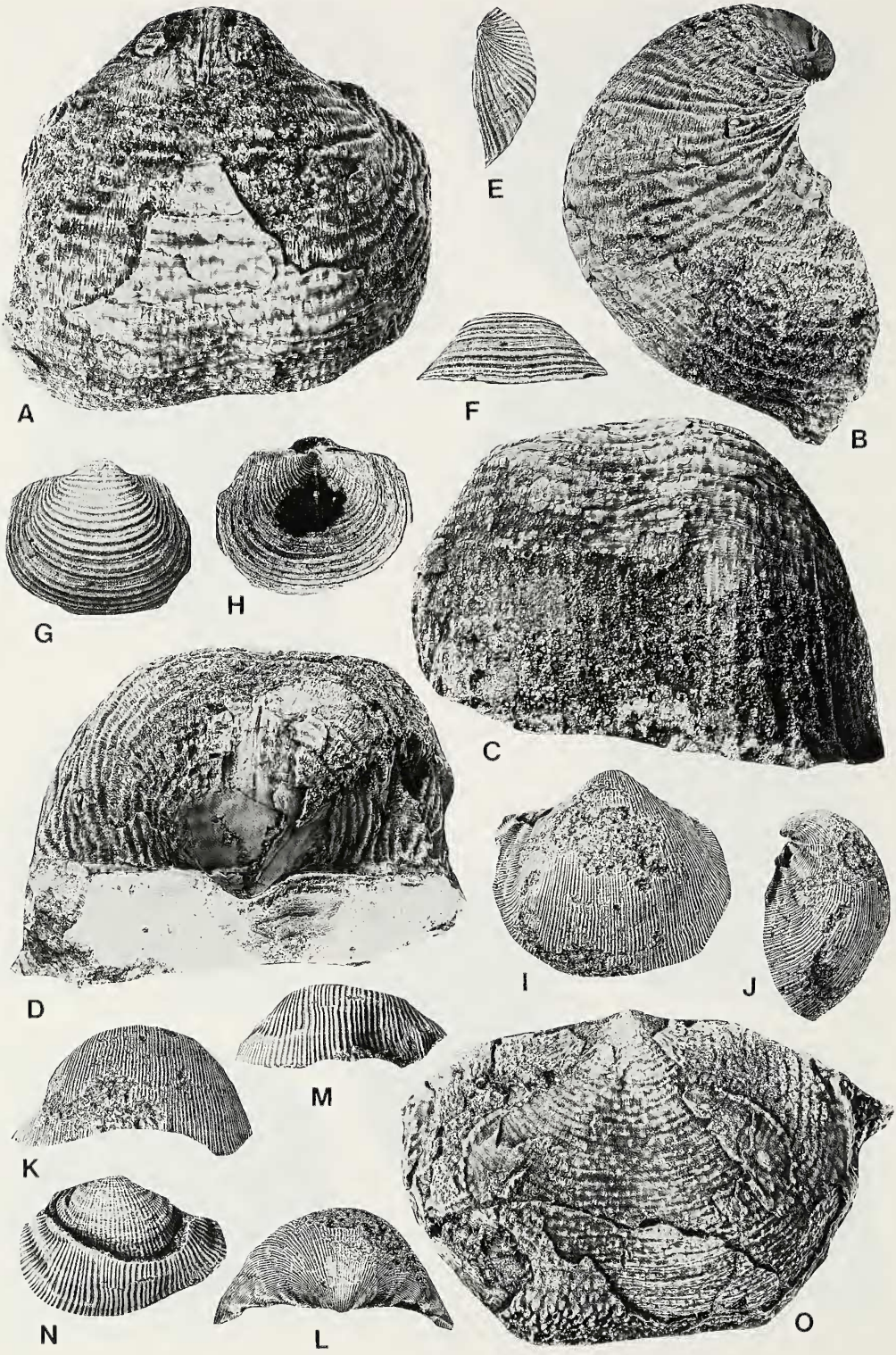
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hingeline; beak incurved; ornament of numerous moderately irregular rugae over entire surface and many elongate spine ridges roughly arranged in quincunx generally on rugae; near anterior margin spine ridges occasionally forming short costae or coarse irregular fluting; interior not observed.

Dorsal valve with weakly concave visceral disc and short geniculate trail with flared marginal rim; fold low, moderately narrow, originating in umbonal region, becoming only moderately higher anteriorly; ears delimited by weakly convex flexures; ornament of somewhat finer rugae than those of ventral valve and shallow rounded pits; numerous fine, apparently erect spine bases scattered over valve in both pits and on rugae; internal details not observed.

Measurements of Types.—See Table 3.

Comparisons.—This new species is most similar to *Pustula pyxidiformis* (Koninck, 1847) from the Lower Viséan of Belgium and the British Isles. The latter is substantially larger, broader, with a narrower deeper fold-sulcus, and coarser ornament and spine bases.

Comments.—This large, strongly convex true *Pustula* is the first such form reported in the United States. As Carter (1987) pointed out, most species referred to this genus have subsequently been reassigned to other genera. He described a true *Pustula* from the Banff Formation of Alberta as *Pustula* cf. *P. pustulosa* (Phillips). This is a much smaller, less transverse species with spreading flanks and is probably not closely related to the present biohermal species.

Material.—In addition to the types there is one large ventral valve in the collection. Several large specimens were left in situ at the quarry. Being found on large, solid blocks they could not be removed with conventional collecting gear except at great expense of time.

Pustula oklahomae, new species
(Fig. 5D–L)

Holotype.—A nearly complete ventral valve, CM 45024, Fig. 5F–I.

Paratypes.—A nearly complete ventral valve, CM 45025, Fig. 5J–L; two natural molds of dorsal exteriors, CM 45026 and 45027, Fig. 5D, E.

Diagnosis.—Medium size, outline transversely subovate, venter flattened but sulcus lacking or very weak, cincture on anterior part of ventral valve of mature specimens, spine ridges regularly arranged in quincunx on ventral valve, becoming elongated anterior to cincture, rugae moderately strong posteriorly, much weaker anterior to cincture, dorsal valve with rugae similar to opposite valve with regular quincuntially arranged, rounded pits and fine, slightly elongated spine bases within pits.

Description.—Medium size for genus, transversely subovate in outline, moderately concavo-convex; maximum width near midlength; fold and sulcus absent or very weak; lateral profile subsemicircular; ears moderately developed, cardinal extremities rounded; trails short; body cavity (corpus) moderately deep.

Ventral valve moderately well inflated, most convex in umbonal region, almost evenly convex in profile except for slight geniculation anterior to cincture; venter flattened or with faint sulcus, flanks

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Fig. 4.—Productoids. A–D, O, *Pustula kenwoodensis* n. sp.; A–D, ventral, lateral, anterior, and posterior views of the holotype, a ventral valve, CM 45018, × 1; O, natural mold of the dorsal exterior, CM 45022, × 1. E–H, *Scutepustula arctifossa* (Moore), lateral, anterior, ventral, and dorsal views, CM 45019, × 1. I–N, *Ovatia laevicosta* (White); I–L, ventral, lateral, anterior, and posterior views of a large ventral valve, CM 45020, × 1; M, N, anterior and ventral views of a dorsal valve and partial ventral valve, CM 45021, × 1.5.

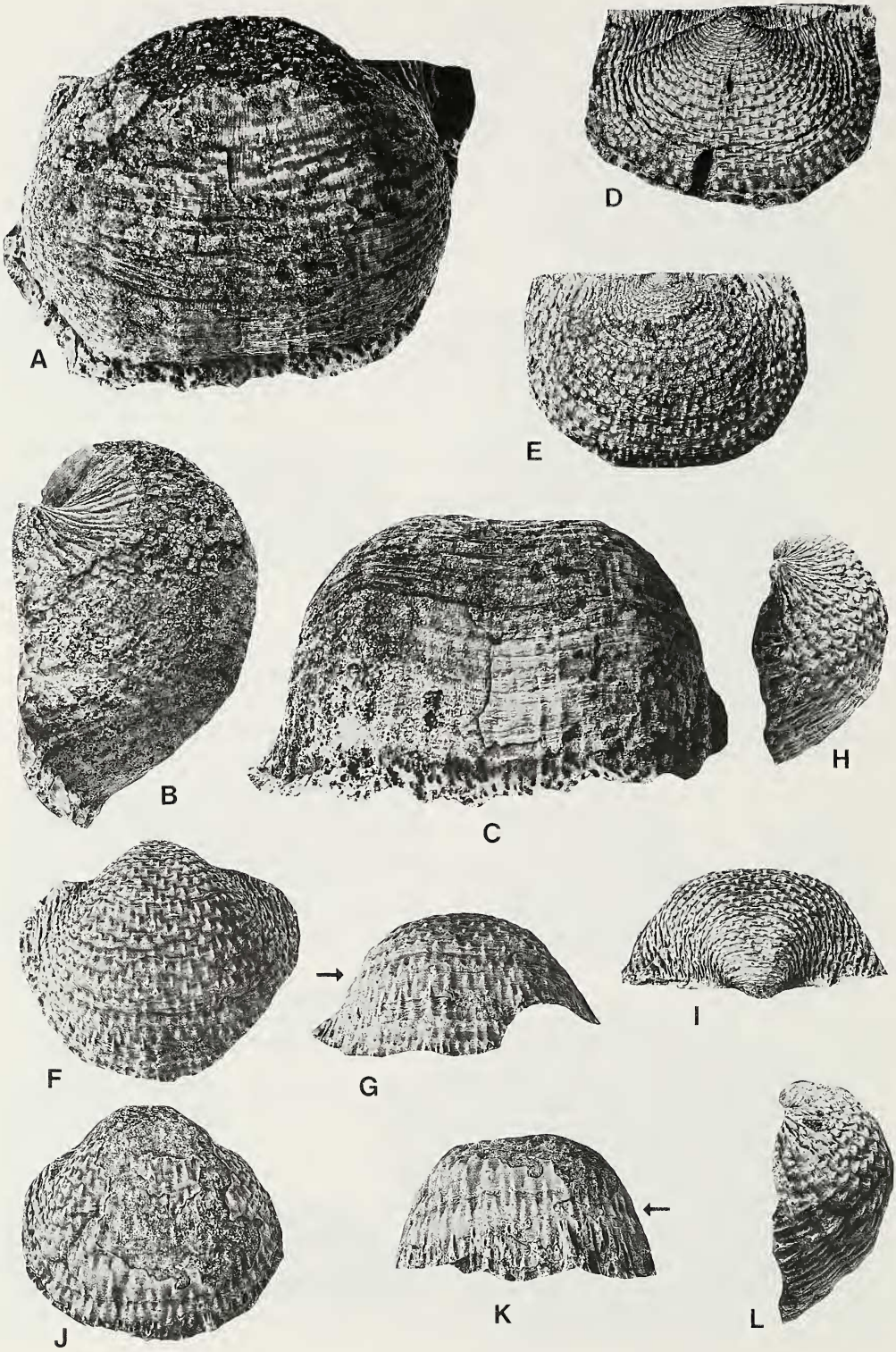
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Table 3.—*Measurements (in mm) of the types of* Pustula kenwoodensis, *n. sp. DV = dorsal valve.*

Number	Length	Width	Height	Surface measure
CM 45018	66.7	+71.7	41.7	118.5
CM 45023	59.8	74.5	32.9	101.5
CM 45022 (DV)	50.7	76.5	13.1	—

sloping moderately steeply to lateral margins; ears small, compressed, delimited by strongly concave flexures; umbonal region of moderate breadth, beak small, incurved, slightly overhanging hingeline; visceral region delimited by distinct cincture in large adults; ornament consisting of numerous low, irregular, discontinuous rugae on visceral region with elongate spine ridges regularly arranged in quincunx; rugae weaker anterior to cincture, spine ridges becoming more elongate, almost costalike; interior not observed.

Dorsal valve weakly to moderately concave, most concave near front margin; ears larger than on ventral valve, defined by convex flexures; dorsum with slight fold, lateral slopes weakly concave; ornament consisting of numerous rugae similar to those of opposite valve and numerous fine, rounded pits arranged in quincunx that become elongated anteriorly; fine spine bases generally disposed in pits, becoming elongated anteriorly; interior with trilobed, dorsally directed cardinal process and low lateral ridges at hingeline; other internal details not observed.

Measurements of Types.—See Table 4.

Comparisons.—This species is similar in size and outline to *Pustula rugata* (Phillips, 1836), from the Viséan of the British Isles and *Pustula pustulosiformis* Rotai, 1931, from the Upper Tournaisian of the Ukraine. It can be differentiated from both of these species by its cincture on the ventral valve of large, mature specimens. In addition, *Pustula rugata* has a more irregular disposition of spine bases on the visceral region of the ventral valve and a stronger fold and sulcus. The specimen of *Pustula pustulosiformis* illustrated by Aizenverg and Poletaev (1971) is similar to this St. Joe species in size and ornament but differs in having a subquadrate outline with larger ears, a slightly less inflated lateral profile, and a shallow sulcus. The specimen of *P. pustulosiformis* illustrated by Fotieva (1964) has a smaller ventral umbo and finer, more costate ornament than *P. oklahomae*. Sarycheva (1963) illustrated a large specimen of *P. pustulosiformis* that is clearly geniculate with a finer, weaker ornament than in the St. Joe species. The specimens of *P. pustulosiformis* illustrated by Kalashnikov (1974) are also geniculate with more closely spaced spine ridges than in our species.

Comments.—Many of the species assigned by Thomas (1914) to his new genus *Pustula* have been assigned to other genera by subsequent authors. The remaining Thomas species are easily differentiated from this St. Joe species in having a distinct fold and sulcus in adult specimens or in obvious differences in outline or ornamentation, with the notable exception of *P. rugata*, as noted above.

Material.—In addition to the types there are 12 other specimens, including two with conjoined valves.

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Fig. 5.—Productoids. A–C, *Pustula kenwoodensis* n. sp., ventral, lateral, and anterior views of a large ventral valve paratype showing the marginal rim, CM 45023. D–L, *Pustula oklahomae* n. sp. D, E, two dorsal valve molds, CM 45026 and 45027; F–H, ventral, anterior, lateral, and posterior views of a ventral valve, the holotype, CM 45024; J–L, ventral, anterior, and lateral views of a ventral valve, CM 45025; all × 1. The small arrows point to the slight cincture on the ventral valves.

Table 4.—*Measurements (in mm) of the types of* Pustula oklahomae, *n. sp. DV = dorsal valve.*

Number	Length	Width	Thickness	Surface measure
CM 45024	31.7	42.9	20.0	52.8
CM 45025	37.4	39.6	19.6	58.5
CM 45026 (DV)	30.1	+43.9	±6.9	—
CM 45027 (DV)	29.4	42.9	±8.2	—

Genus *Scutepustula* Sarycheva, 1963
Scutepustula arctifossa (Moore, 1928)
(Fig. 4E–H)

1928 *Pustula arctifossa* Moore: p. 269, pl. 10, fig. 7–11.

Diagnosis.—The material at hand does not permit differentiation from the type species. Therefore a description of the Kenwood species follows.

Description.—Medium size for genus; transversely subovate in outline, moderately inflated; fold and sulcus absent; greatest width near midlength; lateral profile low, subguttate; ears well developed, cardinal extremities subangular, hinge width slightly less than maximum width; body cavity shallow to moderately deep; trails lacking.

Ventral valve moderately inflated, most convex in umbonal region; venter rounded or slightly flattened, flanks sloping evenly to lateral margins; beak small, narrow, incurved over hingeline; ears delimited by concave flexures; ornament of numerous regular, low, rounded rugae; radial ornament absent; each ruga with single row of closely spaced, fine spines set on narrow, elongated spine ridges that produce striated appearance; ears with dense brush of fine spines; interior not observed.

Dorsal valve weakly concave; ears large, well defined by convex flexures on each side of triangular posteromedial depression; ornament similar to that of opposite valve but rugae finer and more numerous; interior not observed in Kenwood specimens.

Comparisons.—This species is the only representative of this genus in the Lower Carboniferous of North America. It is closely similar to the type species, *Scutepustula scutelata* (Balashova, 1955), from the Tournaisian of the southern Urals. The latter also is described and illustrated by Sarycheva (1963:166, pl. 20, fig. 1–5, text-fig. 670-70) from specimens from the Kuznets Basin. These specimens are almost impossible to differentiate from Moore's types of *S. arctifossa*, the Kenwood specimen illustrated here in Figure 4, and several specimens from the lower Burlington Limestone of Pike County, Missouri. These two species clearly typify the genus. Sarycheva (1963) suggested that several species with unknown interiors might belong here including the species described here. The form described as *Productus* (*Pustula*) *fredericksianus* Paeckelmann, 1931, seems to have a pitted dorsal valve as in true *Pustula* and may not belong in *Scutepustula*. The other species mentioned by Sarycheva (1963) is *Productus fournieri* Demanet, 1923, from the Waulsortian facies of Belgium. This species has very coarse, regular rugae with faint radial "striations" which may represent spine bases. Without better material, assignment of this species to the genus *Scutepustula* would be speculative at best.

Comments.—Moore's holotype and paratypes are from the "lower Burlington white chert" of eastern Missouri and Pierson Formation of southwestern Missouri. These are judged to be about the same age as the St. Joe bioherm at Kenwood. The specimen figured (Fig. 4) is the only mature representative of this species in our Kenwood collection. The species is rare. Besides Moore's types and these Kenwood specimens I have seen only three other specimens from the lower Bur-

lington at Louisiana, Missouri, one of which bears a cardinal process closely similar to that of the type species.

Material.—In addition to the illustrated specimens there are three other specimens, including one ventral valve and two with conjoined valves.

Superfamily Linoproductoidea Stehli, 1954
Family Monticuliferidae Muir-Wood and Cooper, 1960
Subfamily Auriculispinae Waterhouse, 1975
Genus *Ovatia* Muir-Wood and Cooper, 1960
Ovatia laevicosta (White, 1860)
(Fig. 4I–N)

1860 *Productus laevicostus* White: p. 230.

Diagnosis.—Medium-sized, shallow-bodied *Ovatia* with moderately inflated, moderately broad ventral umbo, long trail, and 20–27 ribs per centimeter at surface measure of 2.5 cm from ventral beak.

Comments.—This species was originally described from the late Kinderhookian Wassonville Dolomite of southeastern Iowa. It is moderately common in the late Kinderhookian and early Osagean of the North American midcontinent. It also has been reported at many other localities in the Cordilleran region and the former Soviet Union.

Material.—In addition to the illustrated specimens there are four other specimens, including three ventral valves and one with conjoined valves.

Class Rhynchonellata Williams, Carlson, Brunton, Holmer, and Popov, 1996
Order Orthida Woodward, 1852
Superfamily Enteletoidea Waagen, 1884
Family Schizophoriidae Schuchert, 1929
Subfamily Schizophoriinae Schuchert, 1929
Genus *Schizophoria* King, 1850
Schizophoria mayesensis, **new species**
(Fig. 6A–nn, tt; 7)

Holotype.—CM 45029, Fig. 6F–J.

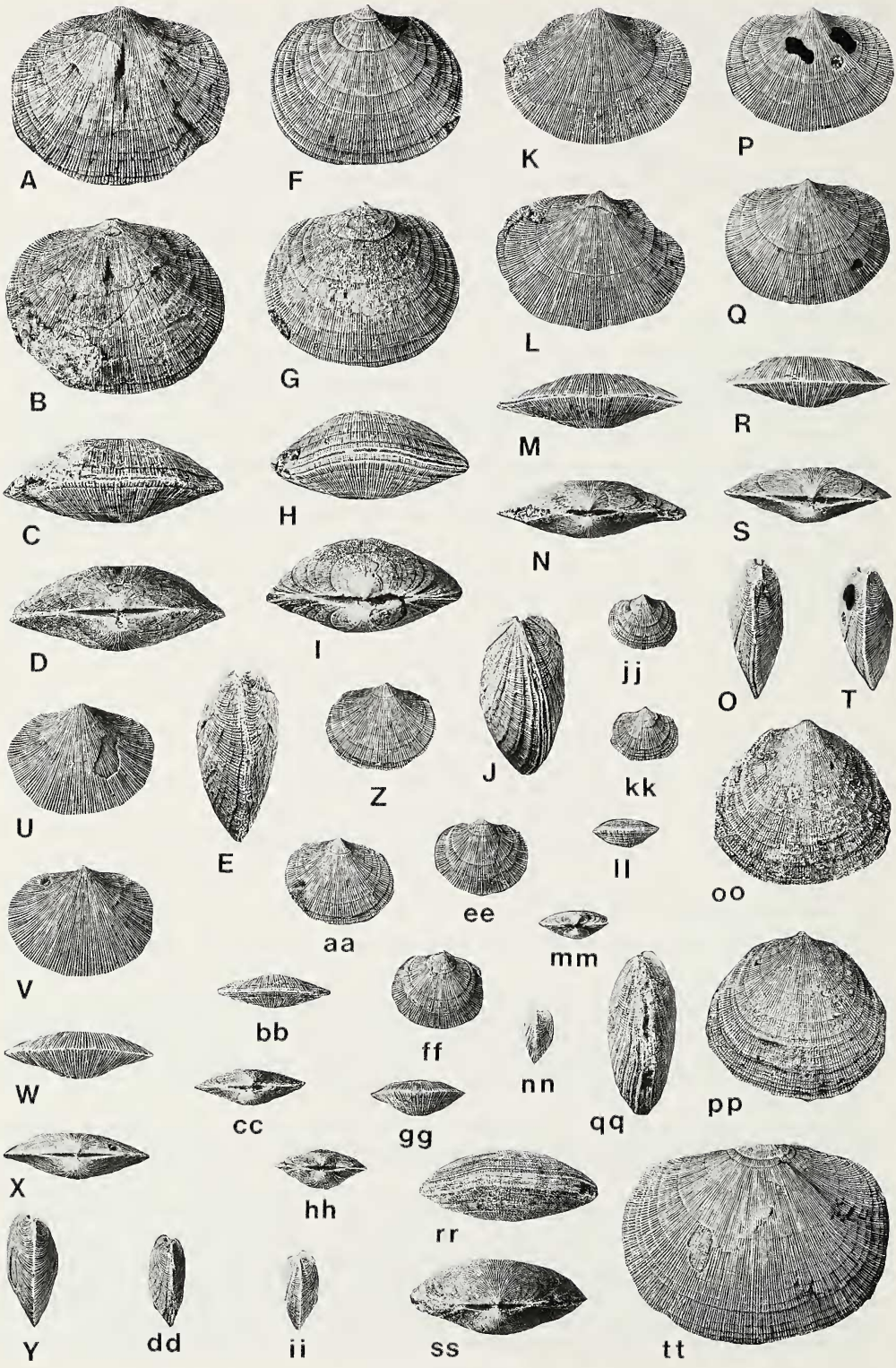
Paratypes.—CM 45028, 45030–45035, Fig. 6A–D, 6K–nn, seven complete specimens; CM 45037, a large dorsal valve, Fig. 6tt.

Diagnosis.—Transverse, nearly equivalve, medium-sized, thin-bodied *Schizophoria* with greatest width usually slightly posterior to midlength; folds and sulci generally lacking but ventral valve often medially flattened anteriorly; ventral interarea very low, forming very acute isosceles triangle.

Description.—Medium size for genus, transversely subelliptical in outline, cardinal extremities rounded, greatest width generally posterior to midlength; subequally biconvex, body thin for genus; lateral profile guttate; hingeline about one-half to two-thirds maximum width.

Ventral valve weakly to moderately convex, most convex in umbonal region with compressed, weakly concave lateral extremities; venter generally flattened to slightly sulcate, anterior commissure straight to weakly uniplicate; umbonal region narrow, extending slightly posterior to hingeline; beak small, pointed, incurved; ventral interarea low, acutely triangular, defined by subangular beak ridges, weakly concave, apsacline, marked by indistinct transverse ridges; delthyrium forming equilateral triangle; interior with short, stout, slightly divergent dental plates and low, thick median ridge that extends forward beyond dental plates; other internal details not observed in thin section.

Dorsal valve thin for genus, about same thickness as ventral valve, rarely thicker or thinner, most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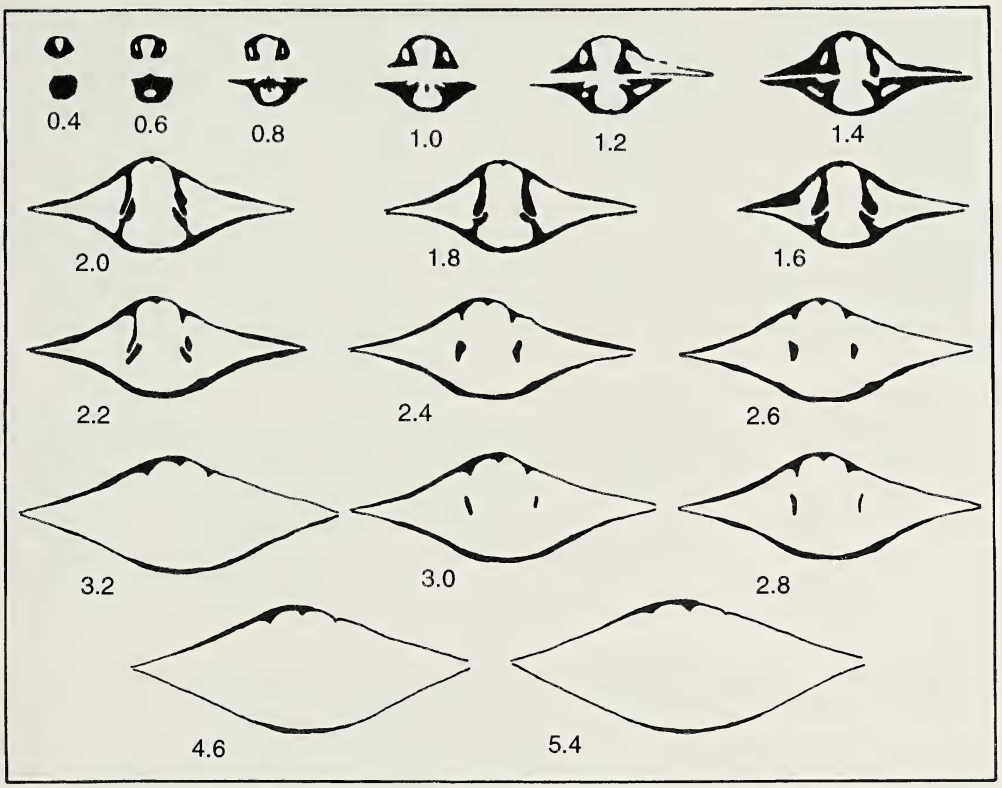

Fig. 7.—Transverse serial sections of *Schizophoria mayesensis* n. sp., CM 45038, × 1.5. Numbers refer to distance from ventral beak (in mm).

convex on dorsum, becoming slightly less convex on flanks, lateral extremities slightly compressed and weakly concave; dorsum generally rounded, rarely with faint sulcus; umbonal region narrow, weakly inflated, with short, acute beak that projects slightly posterior to hingeline; dorsal interarea very low, orthocline to weakly anacline; interior with stout sockets, high and strong inner socket-ridges, thick brachiophores and short, stout brachiophore plates; other internal details not observed from thin sections.

Measurements.—See Table 5.

Comparisons.—This distinctive new species is most similar to *Schizophoria subelliptica* (White and Whitfield, 1862) from the Starr's Cave Oolite of Iowa, *Schizophoria chouteauensis* Weller, 1914, from the Chouteau Limestone of Missouri, and *Schizophoria sedaliensis* Weller, 1914, from the Sedalia Dolomite of central Missouri, all of Kinderhookian or middle Tournaisian age. These species are similar to this new one in being thin-bodied for the genus with a lenticular

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Fig. 6.—Punctate orthids. A–nn, tt, *Schizophoria mayesensis* n. sp. A–nn, ventral, dorsal, anterior, posterior, and lateral views of eight specimens including the holotype (F–J), CM 45029, and eight paratypes CM 45028, 45030–45035; tt, very large disarticulated dorsal valve paratype, CM 45037. oo–ss, *Rhipidomella diminutiva* Rowley, ventral, lateral, dorsal, anterior, and posterior views, CM 45036. All figures × 1.

Table 5.—*Measurements (in mm) of the types of* Schiophoria mayesensis, *n. sp. DV = dorsal valve.*

Number	Length	Width	Thickness
CM 45037 (DV)	29.5	40.3	±7.7
CM 45028	26.2	32.3	12.8
CM 45029	24.3	29.0	13.2
CM 45030	20.5	27.9	8.7
CM 45031	18.5	24.7	8.2
CM 45032	16.7	21.7	7.4
CM 45033	13.0	16.5	5.5
CM 45034	11.6	13.8	5.2
CM 45035	8.2	10.0	4.1

profile. *Schizophoria mayesensis* differs from the first species in its much larger size, smaller ventral umbo, and nearly equally biconvex profile, and the maximum width is generally attained posterior to midlength. It is similar in size to *S. chouteauensis* Weller but can be differentiated by its more transverse outline, more convex ventral valve, almost equally biconvex profile, narrower ventral umbo, and a more posteriorly placed maximum width. It differs from *S. sedaliensis* in being slightly thinner with narrower umbones and a more posteriorly placed maximum width.

Comments.—It seems reasonable to conclude that these four species are closely related. *Schizophoria subelliptica* and *S. chouteauensis* are about the same age and may be sister species. Neither is morphologically well known, internal information completely lacking for both species, so it is impossible to determine which might have given rise to *S. sedaliensis* or *S. mayesensis*. A more germane question concerns the origin of these four relatively thin-bodied schizophorias. There are no similar species in the early Kinderhookian of North America. In the Famennian of North America only *Schizophoria williamsi* Rodriguez and Gutschick, 1978, from the Leatham Formation (Late Famennian) of Utah bears much similarity. Its transverse outline, subequally biconvex valves, and moderately inflated valves suggest a possible relationship with these much younger species.

Material.—In addition to the types there are 52 additional specimens, including 37 articulated specimens.

Superfamily Dalmanelloidea Schuchert, 1913
Family Rhipidomellidae Schuchert, 1913
Subfamily Rhipidomellinae Schuchert, 1913
Genus *Rhipidomella* Oehlert, 1890
Rhipidomella diminutiva Rowley, 1900
(Fig. 6oo–ss)

1900 *Rhipidomella diminutiva* Rowley: p. 261, pl. 5, fig. 41–43.

Diagnosis.—Medium-sized *Rhipidomella* with subovate outline, maximum width invariably anterior to midlength, small, narrow ventral umbo, apsacline ventral interarea of less than half maximum width, generally with very weak ventral sulcus and shallow, narrow dorsal sulcus that originates in dorsal umbo, being lost anteriorly in some specimens.

Comparisons.—*Rhipidomella diminutiva* Rowley is readily differentiated from species of similar age such as *R. jerseyensis* Weller, 1914, or *R. burlingtonensis*

Hall, 1858, by its small, narrow ventral umbo and narrow, shallow dorsal sulcus which often is confined to the umbonal region. *Rhipidomella jerseyensis* is much smaller, has a broad ventral umbo, and a broader, deeper dorsal sulcus forming an emarginate anterior commissure. *Rhipidomella burlingtonensis* has a larger, broader ventral umbo, a better-developed ventral sulcus, a weaker dorsal sulcus, if any, and the maximum width is attained near midlength.

Comments.—This species is rare in the Kenwood collection, consisting of only eight specimens, only one of which is illustrated here. This illustrated specimen is not typical for the species in lacking a clear dorsal sulcus in the umbonal region.

Weller (1914) illustrated several specimens he assigned to this species that are either not typical or misidentified. The specimens he illustrated on his plate 20, figures 9–13 from the lower Burlington white chert are more elongate than any specimens from the same horizon and locality in our collections. The specimen illustrated in figures 16–18 on this same plate do not appear to be assignable to this species, being subquadrate in outline, too thick, and lacking any indication of a narrow, shallow dorsal sulcus. The specimen Weller referred to as *Rhipidomella* sp. in figures 19–21 appears to be an almost typical, if misshapen, *R. diminutiva.*

Material.—In addition to the illustrated specimens there are three articulated and three disarticulated specimens.

Order Rhynchonellida Kuhn, 1949
Superfamily Rhynchotrematoidea Schuchert, 1913
Family Trigonirhynchiidae Schmidt, 1965
Subfamily Trigonirhynchiinae Schmidt, 1965
Genus *Macropotamorhynchus* Sartenaer, 1970
Macropotamorhynchus tuta (Miller, 1881)
(Fig. 8A–D)

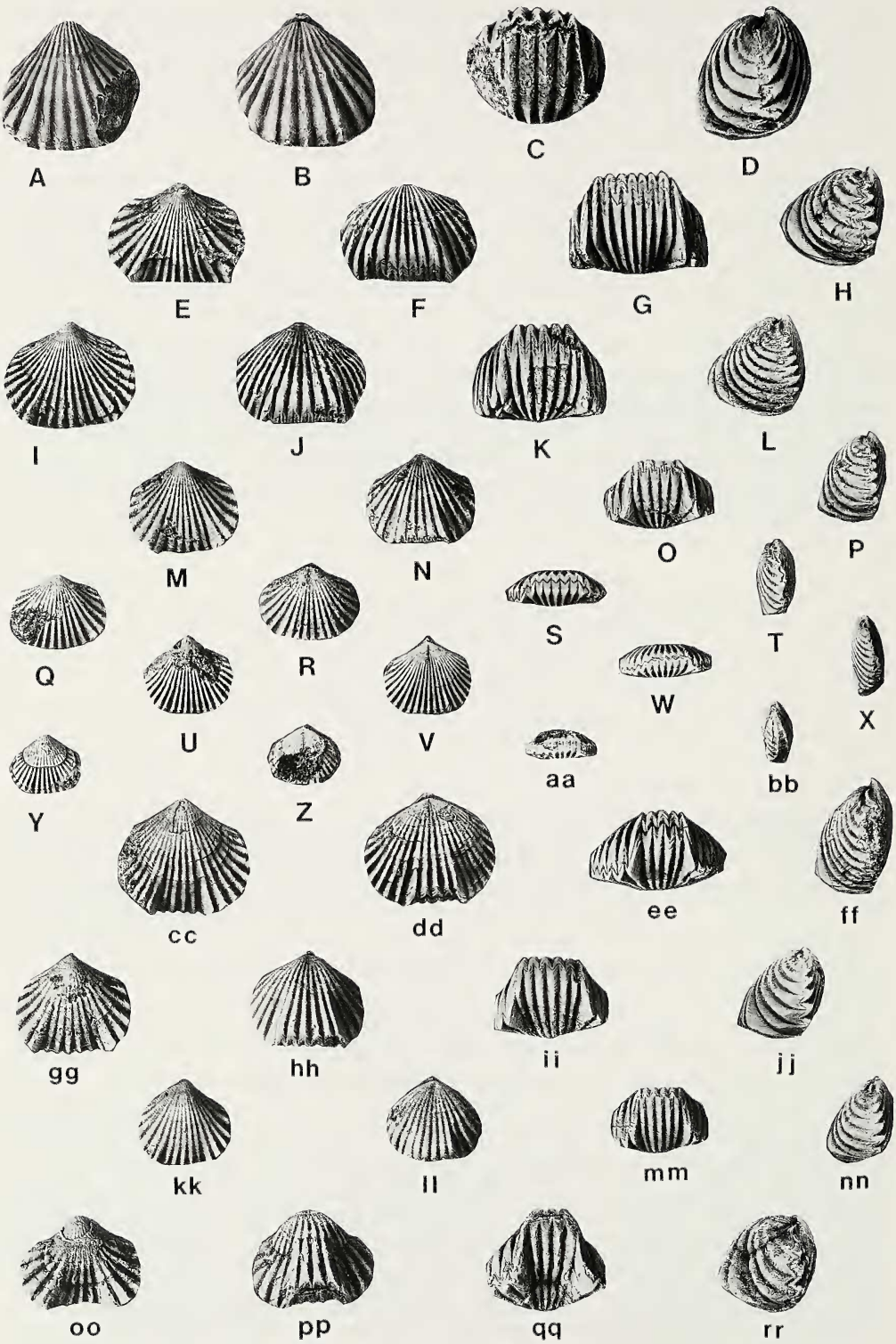
1881 *Rhynchonella tuta* Miller: p. 315, pl. 7, fig. 11.

Diagnosis.—Small, strongly inflated, outline subtrigonal to subovate, length and width subequal or slightly longer than wide, maximum width anterior to midlength; lateral profile subovate; cardinal margins not compressed; ventral beak erect to suberect; ventral valve strongly and evenly convex in profile; dorsal valve moderately thicker with subtrigonal profile; fold and sulcus moderately produced, flattened; fold with five costae, sulcus with four costae, flanks generally with six costae, rarely five.

Comparisons.—This small, rotund species with four costae in the sulcus and six on the flanks is distinctive and easily differentiated from most other species of this genus. It is similar to some specimens of *Macropotamorhynchus insolitus* Carter, 1987, from the Banff Formation of Alberta. That species differs in having compressed cardinal margins, a variable number of ribs on the fold-sulcus and flanks, a more rounded anterior margin, and generally a thinner, less convex ventral valve.

Comments.—This species was named from the Nunn Member of the Lake Valley Formation of New Mexico. It also has been widely identified in North America and the former Soviet Union. If Weller's (1914) identification of this species in the Chouteau Limestone of Missouri is correct, the species ranges from the middle Kinderhookian through the early Osagean in North America.

Material.—The illustrated specimen is the only one in the collection.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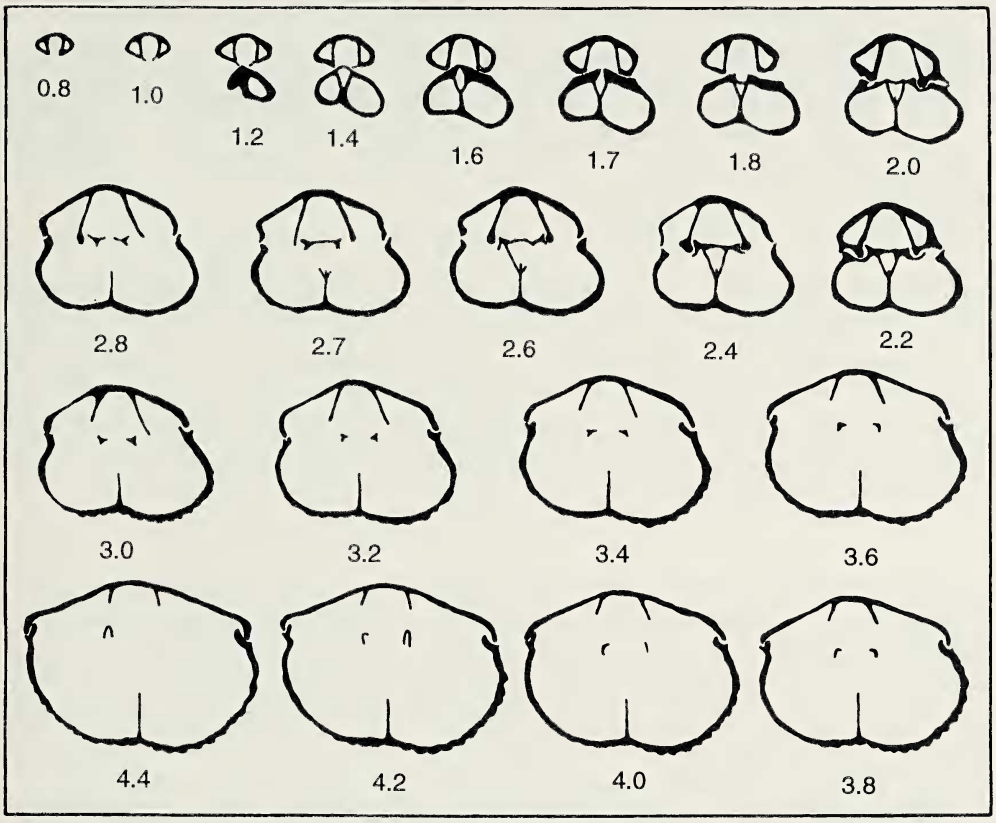

Fig. 9.—Transverse serial sections of *Rhynchopora persinuata* (Winchell), CM 45050, × 2. Numbers refer to distance from ventral beak (in mm).

Superfamily Rhynchoporoidea Muir-Wood, 1955
Family Rhynchoporidae Muir-Wood, 1955
Genus *Rhynchopora* King, 1865
Rhynchopora persinuata (Winchell, 1865)
(Fig. 8E–bb; 9)

1865 *Rhynchonella persinuata* Winchell: p. 121.

Diagnosis.—Medium-sized, transversely subquadrate to subovate *Rhynchopora* with five to nine costae, generally six to eight, in the sulcus and six to ten costae, generally eight or nine, on the flanks of mature shells for a total of about 22–25 ribs per valve.

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Fig. 8.—Rhynchonellids. A–D, *Macropotamorhynchus tuta* (Miller); ventral, dorsal, anterior, and lateral views, CM 45039, × 3. E–bb, *Rhynchopora persinuata* (Winchell), ventral, dorsal, anterior, and lateral views of six specimens, CM 45040–45045, × 1. cc–nn, *Rhynchopora kollari* n. sp., ventral, dorsal, anterior, and lateral views of three specimens including the holotype (cc–ff, CM 45046) and two paratypes CM 45047 and 45048, × 1.5. oo–rr, *Rhynchopora* sp. A, ventral, dorsal, anterior, and lateral views, CM 45049, × 1.5.

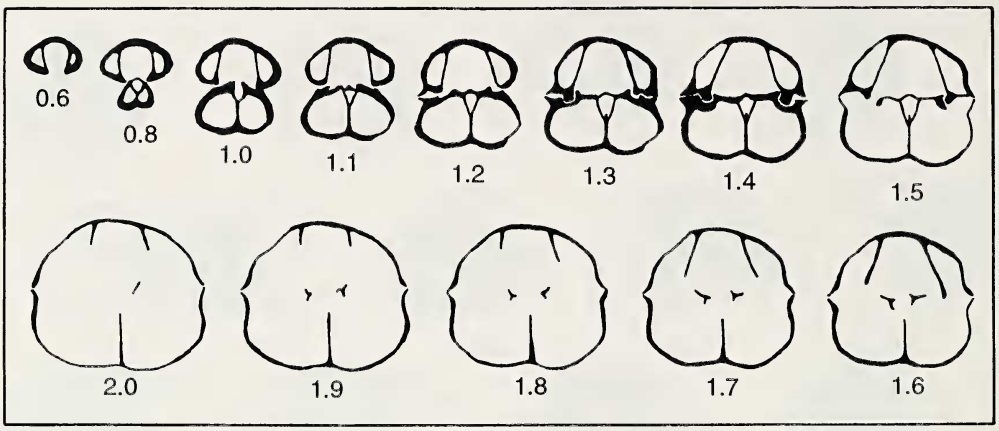

Fig. 10.—Transverse serial sections of *Rhynchopora kollari* n. sp., CM 45051, × 4. Numbers refer to distance from ventral beak (in mm).

Comments.—This species was originally found in the Wassonville Dolomite at Burlington, Iowa, but is common in the Nunn Member of the Lake Valley Formation of New Mexico and Fern Glen Formation of Missouri and Illinois. Weller's (1914) description of the interior did not include an illustration of serial sections and no mention was made of the crura. The interior of a Kenwood specimen of this species shows the rodlike subtrigonal crura that terminate in narrowly arcuate anterior processes (Fig. 9).

This species is similar to *Rhynchopora sansabensis* Carter, 1967, from the Chappel Limestone of central Texas. The latter differs in having more numerous sulcal ribs and fewer lateral ribs with a total of about 18–21 per valve. The stratigraphic range of *R. persinuata* is from the late Kinderhookian through the early Osagean.

Material.—In addition to the illustrated specimens there are 151 articulated specimens.

Rhynchopora kollari, **new species**
(Fig. 8cc–nn; 10)

Holotype.—CM 45046, Fig. 8cc–ff.

Paratypes.—CM 45047 and 45048, Fig. 8gg–nn.

Diagnosis.—Small *Rhynchopora* with transversely subovate outline, moderately wide, flattened fold and sulcus; four to six costae in sulcus, generally five; flanks with six to nine costae, generally six or seven; about 16–21 total costae per valve, generally 18 or 19.

Description.—Small for genus, transversely subovate in outline, dorsibiconvex; fold low, moderately broad, flattened; sulcus shallow, moderately broad, with dorsally directed linguiform extension; surface multicostate with four to six ribs in sulcus, generally five, and six to nine on flanks, generally six or seven; total number of costae about 18 or 19; front margin serrate; shell substance punctate.

Ventral valve much thinner than opposite valve, moderately and evenly convex in lateral profile; umbonal region broad, posterior margins slightly concave in ventral view; beak small, acute, nearly straight or slightly inclined, foramen not observed; flanks weakly convex posteriorly, becoming weakly concave anteriorly; sulcus originating near or anterior to midlength, becoming moderately deep and

Table 6.—*Measurements (in mm) of the types of* Rhynchopora kollari, *n. sp.*

Number	Length	Width	Thickness	Ribs/Sulcus	Ribs/Fold
CM 45046	11.4	12.9	7.1	9	4
CM 45047	10.3	11.3	7.3	6	6
CM 45048	9.0	9.3	5.8	7	5

flattened anteriorly, and forming short to medium, dorsally directed tongue; beak ridges short, subangular, posterior margins compressed; interior with moderately long divergent dental plates; teeth bladelike.

Dorsal valve much more inflated than opposite valve, most inflated anteriorly, forming subtrigonal lateral profile; umbonal region moderately broad with medial depression, dorsal beak inconspicuous, obscured by opposite valve; posterior margins compressed as in opposite valve, forming short flanges on each side of umbones; fold originating near midlength, rising moderately toward front of valve, flattened or weakly concave throughout; moderately convex flanks sloping evenly to lateral margins, steeply to anterior margin; interior with moderately long, deep septalium covered by ventrally convex connectivium; septum long, high, extending well past cardinalia; crura short, broadly to narrowly trigonal in section from rear to front, bladelike anteriorly.

Measurements of Types.—See Table 6.

Comparisons.—This new species is similar in size to *Rhynchopora hamburgensis* Weller, 1910, from the Glen Park Formation (earliest Kinderhookian) of Illinois and Missouri. That species, however, is easily differentiated by its subtrigonal to subpentagonal outline and moderately rounded, not well-flattened, fold and sulcus. Another small species, *Rhynchopora pustulosa* (White, 1860) from the McCraney Limestone (middle Kinderhookian) of southeastern Iowa, is easily differentiated from *R. kollari* n. sp. by its fewer, coarser costae and rounded fold.

Material.—In addition to the types there are 25 articulated specimens.

Rhynchopora species A

(Fig. 8oo–rr)

Description.—Small for genus, transversely subovate in outline, strongly dorsibiconvex with dorsal valve strongly gibbous and longer than ventral valve; lateral profile subovate, globose; fold and sulcus well developed, flattened, narrow; four costae in sulcus, five or six on each flank for a total of 15 per valve; front margin serrate; shell substance finely punctate.

Ventral valve much thinner than dorsal valve, most convex in umbonal region; umbonal region moderately narrow for genus, posterior margins moderately concave in ventral view; beak small, acute, tightly apposed to dorsal umbo; flanks weakly convex; sulcus originating in posterior third of valve, becoming moderately deep anteriorly, forming dorsally directed tongue; beak ridges short, rounded; posterior margins slightly compressed; interior with moderately long, slightly divergent dental plates.

Dorsal valve longer than ventral valve, strongly inflated, with gibbous umbonal region; umbonal region moderately broad, with medial depression, dorsal beak obscured by ventral beak; posterior margins compressed as in opposite valve, forming short flanges on each side of umbo; fold originating posterior to midlength, becoming flattened and moderately high anteriorly; flanks moderately convex posteriorly, sloping steeply to anterolateral margins; interior unknown.

Comments.—This description is based on a single specimen. It is indubitably punctate but quite unlike any *Rhynchopora* I previously have seen. It is possible that it is an aberrant *Rhynchopora kollari* n. sp., as described above, even though it differs in most respects from typical individuals of that species.

Superfamily Stenoscismatoidea Oehlert, 1887
Family Atriboniidae Grant, 1965
Subfamily Atriboniinae Grant, 1965
Genus *Atribonium* Grant, 1965
Atribonium species cf. "*Coledium*" *evexum* Grant 1965
(Fig. 11I–P)

1965 *Coledium evexum* Grant: p. 112, pl. 15, fig. 1–10, text-fig. 26.

Comments.—There are four specimens of stenoscismatoids in the Kenwood collection that are assignable to the genus *Atribonium* Grant, 1965. Two of these specimens have the vertically opposing lateral marginal slopes and a sulcal tongue normal to the lateral margins that are externally characteristic of that genus. All of the specimens also have several fine, weak ribs on the fold and sulcus and on the lateral slopes, which is also typical of *Atribonium*. Only the largest specimen (Fig. 11I–L) would have been suitable for sectioning, leaving no large, well-preserved specimen available for other purposes. In any case the interiors of *Atribonium* are not much different from those of several species of the genus *Coledium* Grant, 1965, the only other likely genus. Assignment to a known species of *Atribonium* is much more difficult.

The only previously described North American species of *Atribonium* of early Mississippian age in the literature are *Atribonium bisinuata* (Rowley, 1900) from the lower Burlington Limestone of eastern Missouri, and the species described by Shaw (1962) as *Stenoscisma obesa* (Clarke, 1917) from the Lodgepole Limestone of Montana. The latter is closely similar to *A. bisinuata*, as Shaw noted (1962: 634), and, as Grant (1965:40) pointed out, is not assignable to *Camarophoria obesa* Clarke, 1917. These species bear a single rib in the sulcus and have smooth lateral slopes, unlike these Kenwood specimens.

The type suite of *Coledium evexum* Grant, 1965, from the Chappel Limestone of central Texas includes two specimens (Grant, 1965:pl. 15, fig. 3, 6) with vertical lateral slopes and tongues as in the genus *Atribonium*. This species also commonly has several weak ribs on the fold and sulcus and lateral slopes as found in these Kenwood specimens. It seems possible that these two specimens were misidentified and belong in *Atribonium*, not *Coledium*. In the meantime this Kenwood specimen can be said to be externally similar to some of Grant's paratyes of *Coledium evexum*.

Material.—In addition to the illustrated specimens there are two small specimens.

Family Stenoscismatidae Oehlert, 1887
Subfamily Stenoscismatinae Oehlert, 1887
Genus *Coledium* Grant, 1965
Coledium simulans (Girty, 1915)
(Fig. 11A–H; 12)

1915 *Camarophoria simulans* Girty, p. 35, pl. 2, fig. 10a–11b.

Diagnosis.—Larger than average for genus, strongly dorsibiconvex *Coledium* with subovate to transversely subelliptical outline; moderately inflated ventral valve; strongly inflated dorsal valve; smooth flanks; narrow fold and deep sulcus, each with one or more weak ribs, generally about four in adults; short suberect beak; rounded beak ridges; moderately long spondylium; moderately long, strongly curved camarophorium; and long, anteriorly free intercamarophorial plate.

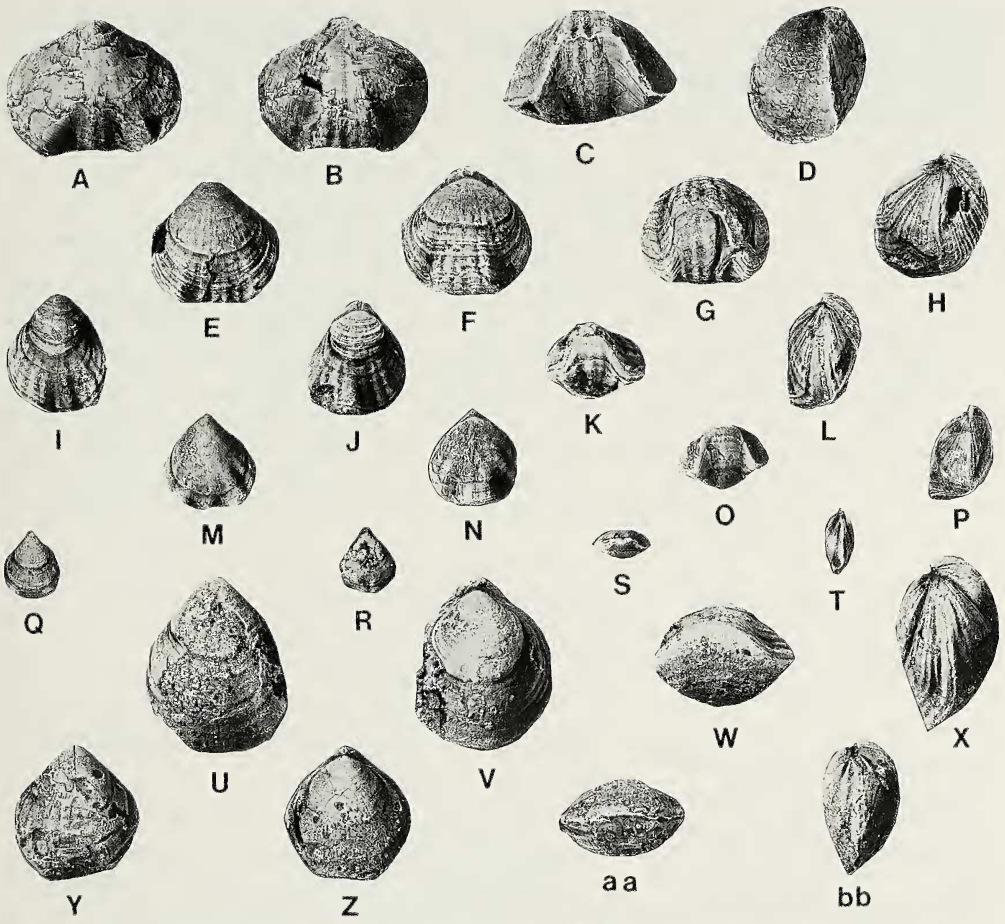

Fig. 11.—Stenoscismatoids and athyridids. A–H, *Coledium simulans* (Girty, 1915), ventral, dorsal, anterior, and lateral views of two specimens, CM 45052 and 45053, × 2. I–P, *Atribonium* sp. cf. *Coledium evexum* Grant 1965, ventral, dorsal, anterior, and lateral views of two specimens, CM 45054 and 45055, × 2. Q–T, ventral, dorsal, anterior, and lateral views of an indeterminate stenoscismatoid juvenile lacking generic characters, CM 45056, × 2. U–bb, *Rowleyella fabulites* (Rowley), ventral, dorsal, anterior, and lateral views of two specimens, CM 45057 and 45058, × 2.

Comments.—This identification is based on three specimens, one of which was sectioned in order to verify the generic identification and prepare Figure 12. The large specimen (Fig. 11A–D) differs from Girty's largest syntype in being considerably more transverse. However, the other specimen in this small Kenwood collection (Fig. 11E–H) is nearly equidimensional and more similar in outline to the smallest of Girty's syntypes although it is proportionally thicker.

In his monograph on the Stenoscismatacea, Grant (1965) did not assign *Camarophoria simulans* (Girty, 1915) to any of his genera. He probably missed it in his search of the stenoscismatoid literature. It is assigned here to the genus *Coledium* Grant on the basis of its angular lateral margins, smooth flanks, and deep, ventrally curving camarophorium.

Coledium simulans is not closely similar to any other known species in this

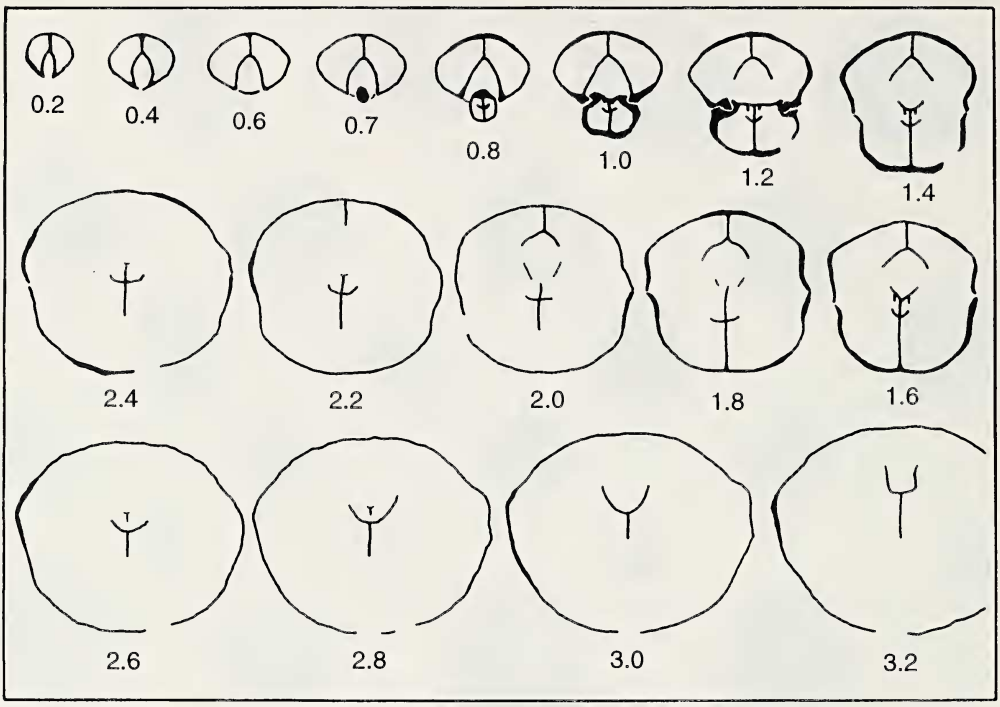

Fig. 12.—Transverse serial sections of *Coledium simulans* (Girty), CM 45059, × 4. Numbers refer to distance from ventral beak (in mm).

genus. *Coledium altisulcatum* Carter, 1967, from the Chappel Limestone of central Texas is similar in size and general shape but differs in having a much more inflated dorsal umbo and a stronger, wider, more rounded fold and sulcus.

Material.—In addition to the illustrated specimens there are nine other smaller immature specimens of this genus, presumably assignable to this species.

Order Athyridida Boucot, Johnson, and Staton, 1965
Suborder Athyridina Boucot, Johnson, and Staton, 1965
Superfamily Meristelloidea Waagen, 1883
Family Camarophorellidae Schuchert, 1929
Subfamily Camarophorellinae Schuchert, 1929
Genus *Camarophorella* Hall and Clarke, 1893
Camarophorella species
(Fig. 13I–L)

Comments.—There is a single complete specimen of the genus *Camarophorella* in this collection. It is medium in size, transversely subovate in outline, and relatively thin-bodied. There is a weak, shallow ventral sulcus and a faint dorsal, medial groove anteriorly that produces a slight anterior emargination. Internally there are distinct median septa as seen through the translucent shell material. Also apparent is a dorsal shoe-lifter process originating less than one millimeter in front of the hingeplate.

Identification of this species is not possible from a single specimen. It is similar

in outline to smaller specimens of *Camarophorella dorsata* Carter, 1967, from the Chappel Limestone of central Texas but differs in being much thinner and has a longer ventral beak. *Camarophorella mutabilis* Hyde, 1908, from the Waverly of Ohio differs in being larger and thicker, and has a better developed ventral sulcus.

Subfamily Rowleyellinae Alvarez and Brunton, 1995
Genus *Rowleyella* Weller, 1911
Rowleyella fabulites (Rowley, 1900)
(Fig. 11U–bb)

1900 *Terebratula fabulites* Rowley: p. 265.
1991*a* *Rowleyella fabulites* (Rowley): Carter, p. 84, fig. 1C–Q; fig. 2.

Diagnosis (for Both Genus and Species).—Small elongate terebratuliform camarophorellids with weak fold-sulcus externally and short shoelifter process with long cruralium in dorsal valve.

Comments.—This rare species is previously known only from the lower Burlington Limestone of Pike County, Missouri.

Material.—Only the illustrated specimens were recovered.

Family Athyrididae Davidson, 1881
Subfamily Athyrididae Davidson, 1881
Genus *Lamellosathyris* Jin and Fang, 1983
Lamellosathyris lamellosa (Léveillé, 1835)
(Fig. 13A–H; 14)

1835 *Spirifer lamellosus* Léveillé: p. 39, pl. 2, fig. 21–23.
1980 *Actinoconchus lamellosus* (Léveillé): Brunton, p. 225, fig. 15–17.

Diagnosis.—Large transverse *Lamellosathyris* with subovate to subelliptical outline, ventral sulcus well developed anteriorly in adults, dorsal fold which may be rounded or have weak medial sulcus, rounded uniplicate anterior commissure and well-defined rugae with corrugated lamellar extensions.

Comments.—Brunton (1980) selected and illustrated a neotype for this species from the Upper Tournaisian (Tn3b) of Belgium. This neotype differs from the specimens illustrated here only in being about half their size. *Lamellosathyris lamellosa* is readily differentiated from *L. bradyensis* (Carter, 1967) from the Chappel Limestone of central Texas by its much larger size, stronger fold-sulcus, and narrower, more rounded cardinal extremities.

Material.—In addition to the illustrated specimens there are 24 articulated specimens.

Genus *Crinisarina* Cooper and Dutro, 1982
Crinisarina prouti (Swallow, 1860)
(Fig. 13M–P)

1860 *Spirigera proutii* Swallow: p. 649.

Diagnosis.—Transverse, strongly and almost equally biconvex medium-sized *Crinisarina* with strong, moderately narrow fold and sulcus.

Comments.—This species is readily distinguished from most Devonian representatives of this genus by its transverse outline and well-developed fold and sulcus. In this respect it is similar to *C. reticulata* (Stainbrook) from the Rhodes Canyon Formation (Famennian) of New Mexico, which can be differentiated by its less transverse outline and much wider fold-sulcus.


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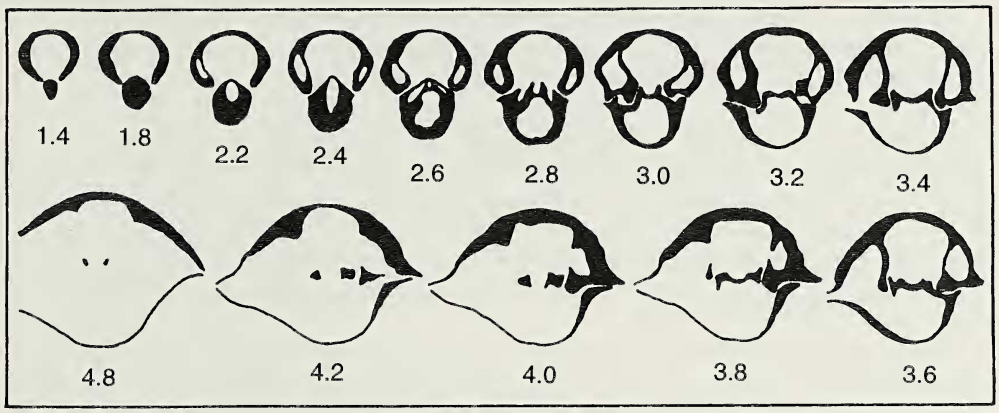

Fig. 14.—Transverse serial sections of *Lamellosathyris lamellosa* (Léveillé), CM 45064, × 1.5. Numbers refer to distance from ventral beak (in mm).

Material.—In addition to the illustrated specimen there is one small complete specimen and one ventral valve.

Genus *Cleiothyridina* Buckman, 1906
Cleiothyridina cf. *C. glenparkensis* Weller, 1914

1914 *Cleiothyridina glenparkensis* Weller: p. 473, pl. 78, fig. 21–24.

Comments.—In this collection there are three poor athyridid specimens with closely spaced growth lamellae fringed with flattened spines characteristic of the genus *Cleiothyridina* Buckman. The best of these specimens is of medium size, transversely subovate in outline, and thin-bodied. In size and outline it resembles *Cleiothyridina glenparkensis* Weller but differs in being much less inflated. One other, more incomplete specimen is slightly thicker but still less thick than *C. glenparkensis.*

Order Spiriferida Waagen, 1883
Suborder Spiriferidina Waagen, 1883
Superfamily Martinioidea Waagen, 1883
Family Martiniidae Waagen, 1883
Subfamily Eomartiniopsinae Carter, 1994
Genus *Eomartiniopsis* Sokolskaya, 1941
Eomartiniopsis rostrata (Girty, 1899)
(Fig. 15E–X; 16)

1899 *Martinia rostrata* Girty: p. 553–554, pl. 70, fig. 5a–g.
1972 *Eomartiniopsis rostrata* Girty: Carter, p. 487, pl. 2, fig. 1–11; text-fig. 6.
1987 *Eomartiniopsis rostrata* Girty: Carter, p. 85, pl. 2, fig. 30; pl. 27, fig. 27–42; text-fig. 25.

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Fig. 13.—Athyridids. A–H, *Lamellosathyris lamellosa* (Léveillé), ventral, lateral, dorsal, and anterior, views of two large specimens, CM 45060 and 45061, × 1. I–M, *Camarophorella* sp., ventral, dorsal, anterior, and lateral views, CM 45062, × 1.5. M–P, *Crinisarina prouti* (Swallow), ventral, dorsal, anterior, and lateral views, CM 45063, × 1.5.

Diagnosis.—Medium to large, generally transversely subovate *Eomartiniopsis* with noncostate lateral slopes, rounded fold-sulcus, narrow, poorly delineated ventral interarea, moderately produced ventral umbonal region, and lacking crural plates.

Comments.—This species was described from the Lodgepole Formation of the Madison Group in Yellowstone National Park. Carter (1972, 1987) subsequently described specimens assigned to this species from the latest Kinderhookian Gilmore City Formation of Iowa and the Banff Formation of Alberta where it ranges from late Kinderhookian into the early Osagean. The interior of these Kenwood specimens (Fig. 16) is closely similar to the specimens sectioned by Carter (1972, 1987) from Iowa and Alberta.

Eomartiniopsis tscherepeti Sokolskaya, 1941, from the Upper Tournaisian of the Russian Platform and *Eomartiniopsis grandiformis* Plodowski, 1968, from the Viséan of Afghanistan are similar in size and outline to *E. rostrata*. Sokolskaya's (1941:pl. 7, fig. 7–9) types differ little from medium-sized specimens of *E. rostrata* and it may be a junior synonym of this species. However, dorsal valves of *E. tscherepeti* were not known to Sokolskaya nor was an entire shell sectioned so the interior is poorly known. *Eomartiniopsis grandiformis* Plodowski differs from *E. rostrata* in its larger, more extended ventral umbonal region and the presence of crural plates inside the dorsal valve.

Material.—In addition to the illustrated specimens there are 33 other specimens, including 11 articulated and 21 single valves.

Eomartiniopsis, **new species**
(Fig. 15A–D)

Comments.—A single large specimen of martiniid is assigned to the genus *Eomartiniopsis* on the basis of having a smooth shell with dental adminicula in the ventral valve. This unique specimen is unlike any other species of *Eomartiniopsis* known to me in its unusually large size, transversely subelliptical outline, and rather broad, flattened fold-sulcus. The ventral beak is broken, revealing thickened dental adminicula of indeterminate length and the dorsal umbo is spalled (Fig. 15D). A pair of thick, low ridges can be seen extending forward and defining an impressed dorsal muscle field. These ridges do not appear to be true plates but such ridges are not known in other *Eomartiniopsis* to my knowledge.

Family Gerkispiridae Carter, 1985
Genus *Punctothyris* Hyde, 1953
Punctothyris kenwoodensis Carter, 1985
(Fig. 20C–F)

1985 *Punctothyris kenwoodensis* Carter: p. 387, fig. 2E, 5–7.

Diagnosis.—Medium-sized *Punctothyris* with subcircular outline, rotund profile, eight to 11 lateral costae and zero to three sulcal costae.

Comments.—This is a common element in the Kenwood fauna there being in excess of 20 more-or-less complete specimens. It was illustrated and diagnosed by Carter (1985).

Superfamily Spiriferoidea King, 1846
Family Spiriferidae King, 1846
Subfamily Spiriferinae King, 1846
Genus *Spirifer* Sowerby, 1818
Subgenus *Mesochorispira* Carter, 1992
Spirifer (*Mesochorispira*) *grimesi* (Hall, 1858)
(Fig. 17A–D)

1858 *Spirifer grimesi* Hall: p. 604, pl. 14, fig. 1–5.

Diagnosis.—Large transverse *Mesochorispira* with moderately broad, well-developed, rounded fold-sulcus, greatest width at or near midlength and moderately coarse costae.

Comments.—This species is commonly identified from many localities and Osagean horizons in North America and abroad. It is characteristic of the Burlington Limestone and ranges throughout much of that formation and coeval strata in the midcontinent and the Cordilleran region. It is commonly confused with *Spirifer* (*Mesochorispira*) *logani* Hall, 1858, of Lower Viséan age, which generally has somewhat coarser costae and well-developed auriculations forming a wide hingeline.

Material.—In addition to the illustrated specimen there are 15 articulated shells and seven disarticulated valves.

Family Imbrexiidae Carter, 1992
Genus *Fernglenia* Carter, 1992
Fernglenia vernonensis (Swallow, 1860)
(Fig. 17E, F)

1860 *Spirifer vernonensis* Swallow: p. 644.
1992 *Fernglenia vernonensis* Swallow: Carter, p. 329, fig. 1.1–1.11, 2.

Diagnosis.—Medium-sized transverse *Fernglenia* with strong, well-defined, moderately broad fold-sulcus, moderately coarse costae with few bifurcations, long dental adminicula, and protuberant stegidium or stegidial plates.

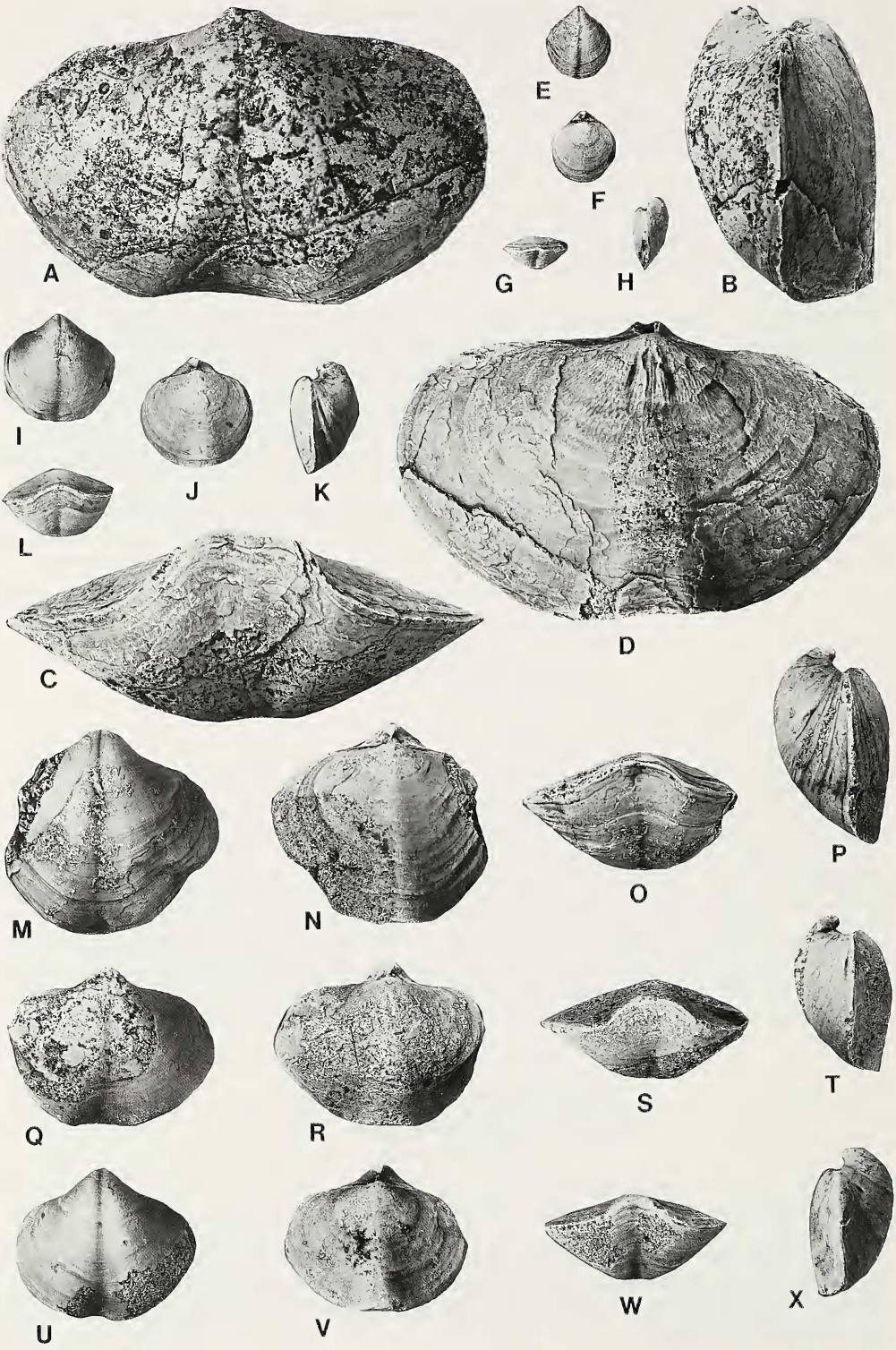
Comments.—This species was described from the Fern Glen Formation of eastern Missouri but also occurs in the Pierson Formation of southwestern Missouri, the St. Joe Formation of northern Arkansas and northeastern Oklahoma, the New Providence Shale of Kentucky, the Lake Valley and Keating formations of New Mexico, and the Redwall Limestone of Arizona. Related but undescribed species occur in the Caballero Formation of New Mexico and Banff Formation of Alberta.

Material.—In addition to the illustrated specimen there are two other ventral valves.

Genus *Tegulocrea* Carter, 1992
Tegulocrea incerta (Hall, 1858)
(Fig. 18A–D)

1858 *Spirifer incertus* Hall: p. 602, pl. 13, fig. 3.
1992 *Tegulocrea incerta* (Hall): Carter, p. 331, fig. 3.1–3.34, 4.

Diagnosis.—Medium-sized transverse subsemicircular *Tegulocrea* with mucronate lateral extremities in adults, with numerous bifurcating or trifurcating medium-coarse costae or costellae, and with very short dental adminicula and little apical callus internally.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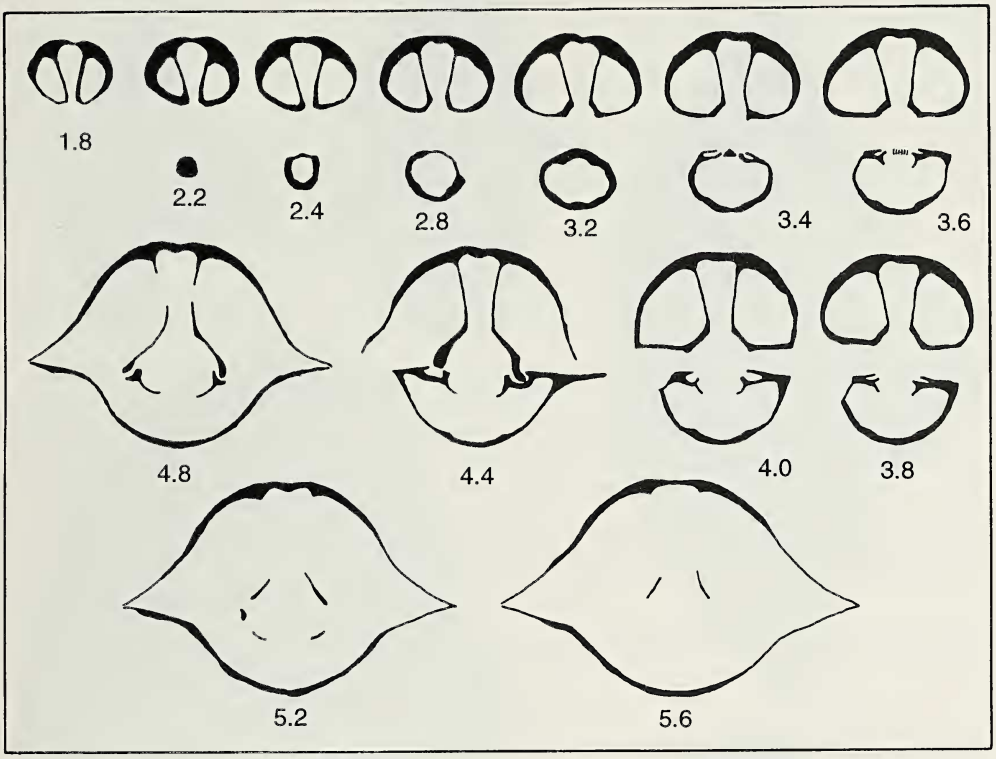

Fig. 16.—Transverse serial sections of *Eomartiniopsis rostrata* (Girty), CM 45071, × 1.5. Numbers refer to distance from ventral beak (in mm).

Comments.—Hall's (1858) type of this species is from the Burlington Limestone at Burlington, Iowa. The horizon within the Burlington is not known and, despite Weller's (1914) contention that it is a common Burlington element, is rare in my collections except for these Kenwood specimens. Most of Hall's (1858) Burlington brachiopod types are from the lowest subdivision, the Dolbee Creek Member, and provenience at that level would be in agreement with the occurrence of these St. Joe specimens.

Carter (1992) assigned *Spirifer tenuicostatus* Hall, 1858, and *Spirifer tenuimarginatus* Hall, 1858, to the genus *Tegulocrea*. The former differs from *T. incerta* in being finer-ribbed and having longer dental adminicula with a thick apical callus. The latter is known only from Hall's type which is small, rounded in outline, only moderately transverse, and with finer ribbing than *T. incerta*. Weller (1914) suggested that the type of *T. tenuimarginatus* might represent an aberrant individual of *T. tenuicostus*.

Material.—In addition to the illustrated specimen there are ten articulated and

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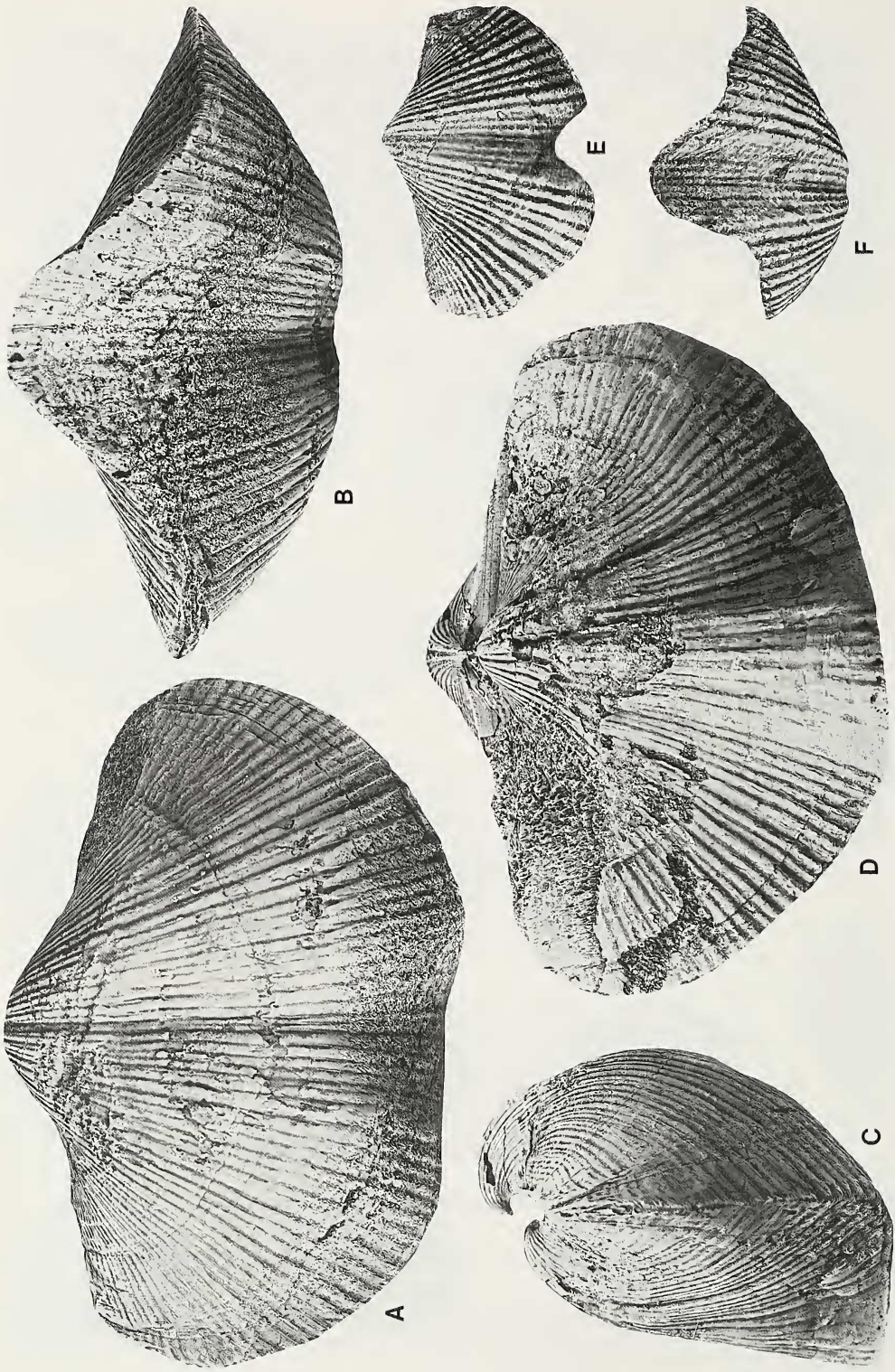
Fig. 15.—Martinioids. A–D, *Eomartiniopsis* n. sp., ventral, lateral, anterior, and dorsal views, CM 45065. E–X, *Eomartiniopsis rostrata* (Girty), ventral, dorsal, anterior, and lateral views of five specimens, CM 45066–45070. All figures × 1.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eight ventral valves. Carter (1992) illustrated a growth series of seven specimens from this collection.

Superfamily Paeckelmannelloidea Ivanova, 1972
Family Strophopleuridae Carter, 1974
Subfamily Strophopleurinae Carter, 1974
Genus *Voiseyella* Roberts, 1963
Voiseyella novamexicana (Miller, 1881)
(Fig. 18E–L; 19)

1881 *Spirifera novamexicana* Miller: p. 314, fig. 10–10b.
1967 *Amesopleura novamexicana* (Miller): Carter, p. 366, pl. 33, fig. 9–12, text-fig. 29.

Diagnosis.—Alate to slightly mucronate, gerontically geniculate *Voiseyella* with seven to nine costae on each flank and procline to catacline ventral interarea; internally with a dorsal umbonal callus and short dental adminicula.

Comments.—*Voiseyella texana* (Carter, 1967) from the Chappel Limestone of central Texas, the only other North American Osagean species, differs in its less transverse outline, apsacline ventral interarea, nongeniculate growth form, and thickened dental adminicula. The type species, *Voiseyella anterosa* (Campbell, 1957) from the Middle Viséan of eastern Australia, is smaller, has fewer ribs, and lacks a median dorsal groove.

Material.—In addition to the illustrated specimens there are five articulated and three disarticulated specimens.

Superfamily Brachythyridoidea Frederiks, 1924
Family Brachythyrididae Frederiks, 1924
Genus *Brachythyris* McCoy, 1844
Brachythyris chouteauensis Weller, 1909
(Fig. 18M–X)

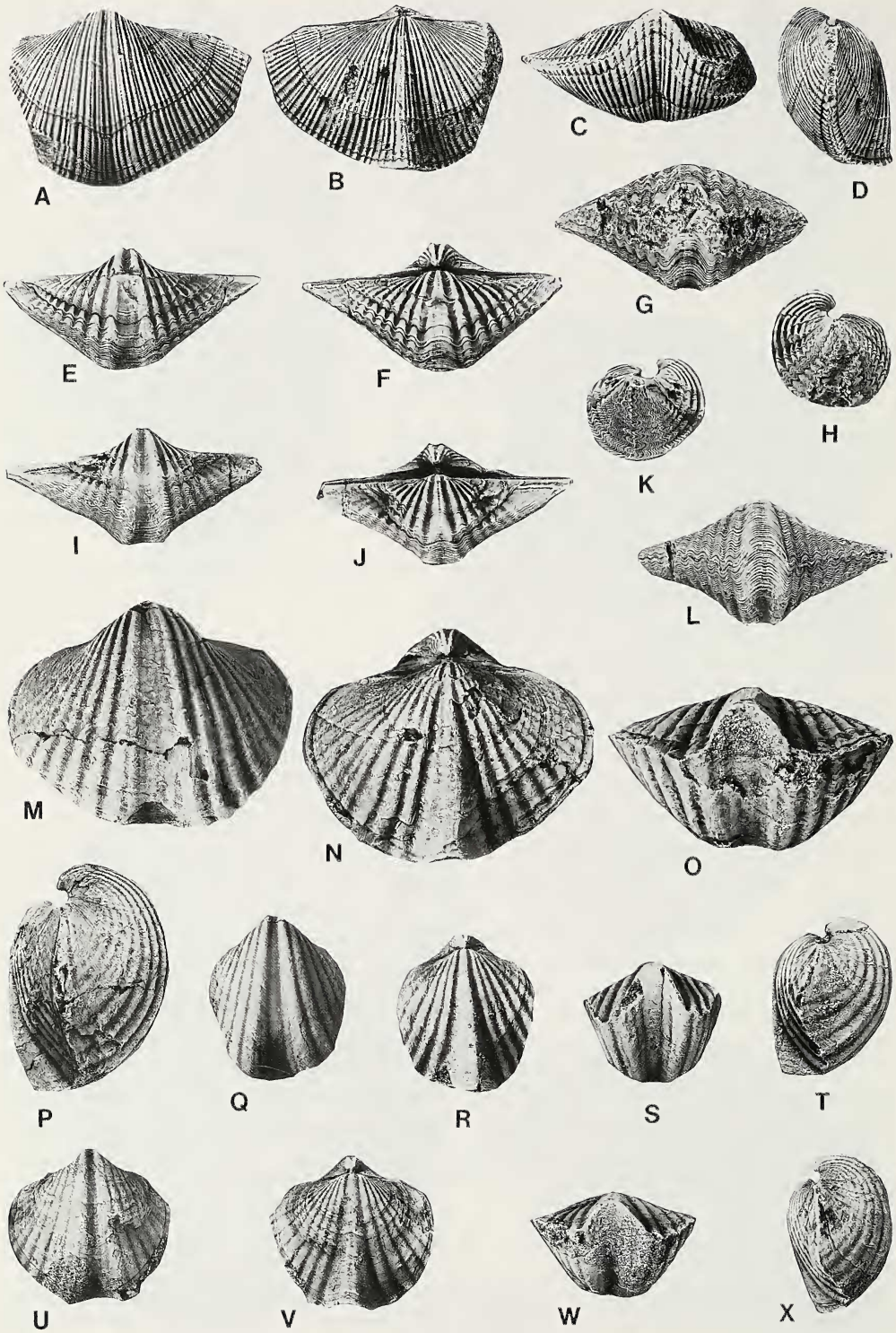
1909 *Brachythyris chouteauensis* Weller: p. 305, pl. 13, fig. 11.

Diagnosis.—Medium-sized *Brachythyris* of rounded outline, proximate beaks, slightly compressed ventral umbonal region, low, wide ventral interarea that is well defined by subangular beak ridges, seven to 11 costae per flank, and one or two pairs of weak or very faint costae on the sides of the sulcus.

Comments.—In this continent there are two Lower Mississippian species of the genus *Brachythyris* that are similar in profile and outline to *B. chouteauensis* Weller. These are *Brachythyris suborbicularis* (Hall, 1858) from the upper Burlington and Keokuk limestones of the midcontinent and *Brachythyris hortonensis* Carter, 1988, from the Glen Park Formation of east-central Missouri and adjacent portions of Illinois. *Brachythyris suborbicularis* is much larger than *B. chouteauensis* and has correspondingly coarser ribbing and wider hingeline. *Brachythyris hortonensis* has a transversely subovate outline, broader umbonal region, three sulcal costae, and a median groove on the dorsal fold.

←

Fig. 17.—Spiriferoids. A–D, *Spirifer* (*Mesochorispira*) *grimesi* (Hall), ventral, anterior, lateral, and dorsal views of a large specimen, CM 45072. E, F, *Fernglenia vernonensis* (Swallow), ventral and anterior views of a large ventral valve, CM 45073. All figures × 1.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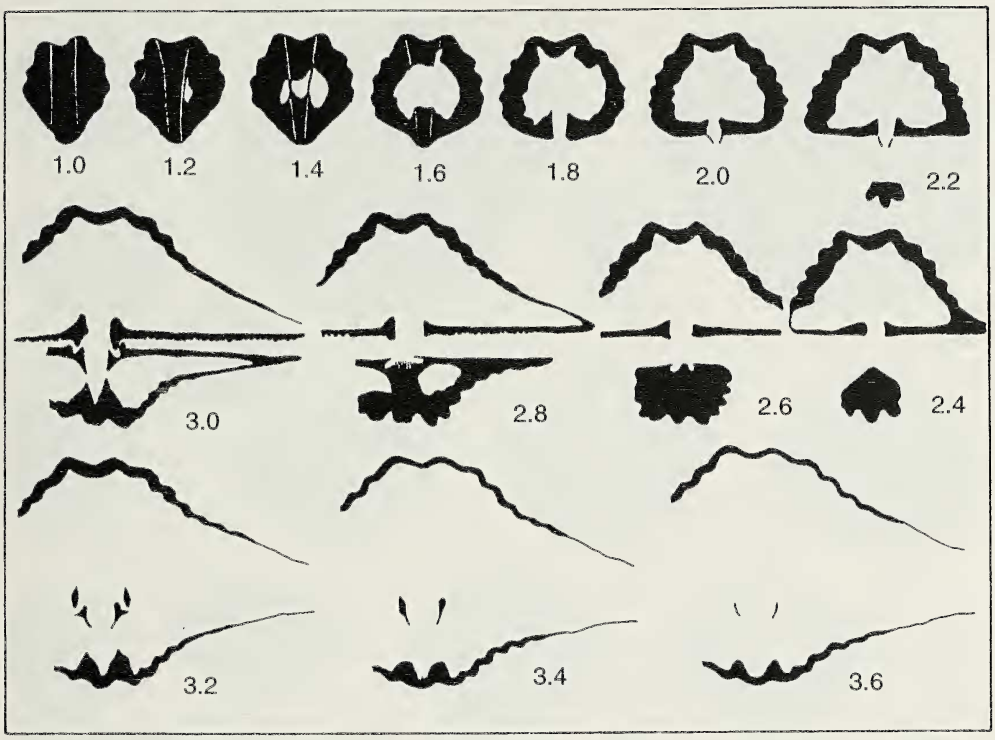


Fig. 19.—Transverse serial section of *Voiseyella novamexicana* (Miller), CM 45080, × 3. Numbers refer to distance from ventral beak (in mm).

Material.—In addition to the illustrated specimens there are ten articulated and 21 disarticulated specimens.

Suborder Delthyridina Ivanova, 1972
Superfamily Reticularioidea Waagen, 1883
Family Elythidae Frederiks, 1924
Subfamily Elythinae Frederiks, 1924
Genus *Kitakamithyris* Minato, 1951
Kitakamithyris cooperensis (Swallow, 1860)
(Fig. 20G–Z)

1860 *Spirifer cooperensis* Swallow: p. 643.
1967 *Reticularia? cooperensis* (Swallow): Carter, p. 405, pl. 40, fig. 1–7, text-fig. 41.

Diagnosis.—Medium-sized transverse elythins with a subelliptical outline, weakly developed fold-sulcus, and moderately narrow, ventral umbonal region

←

Fig. 18.—Spiriferoids, paeckelmanelloids, and brachythyridoids. A–D, *Tegulocrea incerta* (Hall), ventral, dorsal, anterior, and lateral views, CM 45074, × 1. E–L, *Voiseyella novamexicana* (Miller), ventral, dorsal, anterior, and lateral views of two specimens, CM 45075 and 45076, × 1.5. M–X, *Brachythyris chouteauensis* (Weller), ventral, dorsal, anterior, and lateral views of three specimens, CM 45077–45079, × 1.

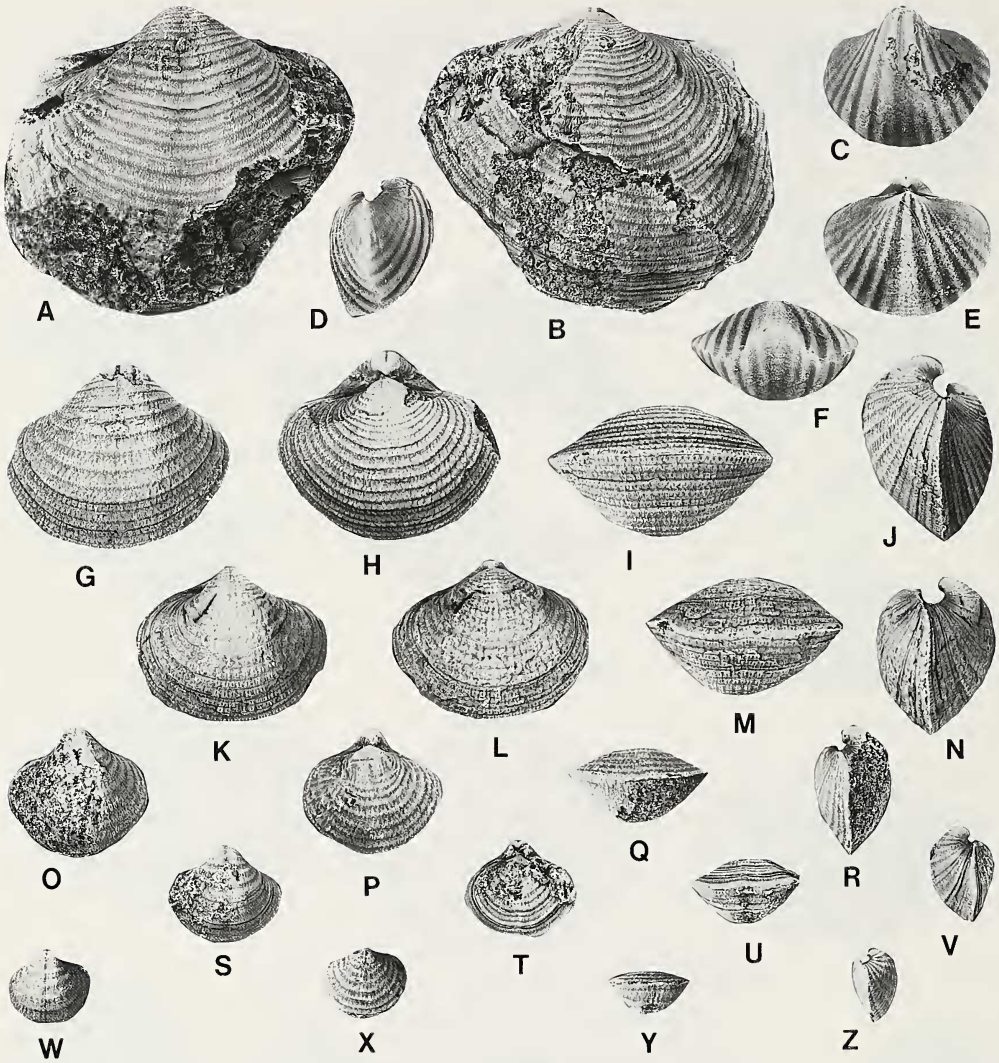


Fig. 20.—Reticularioids. A, B, ?*Torynifer* sp., ventral and dorsal views of a large specimen, CM 45081, × 1. C–F, *Punctothyris kenwoodensis* Carter, ventral, lateral, dorsal, and anterior views, CM 45082, × 1.5. G–Z, *Kitakamithyris cooperensis* (Swallow), ventral, dorsal, anterior, and lateral views of five specimens, CM 45083–45087, × 1.5.

that extends slightly posterior to the hingeline; internally with short, slightly divergent dental adminicula and low, thin median ridges in both valves that extend to about midlength.

Comments.—There are few other representatives of this genus in North America. *Reticularia setigera* var. *internascens* Girty, 1928, from the silicious middle Boone Formation (Lower or Middle Viséan) of northeastern Arkansas, may belong in this genus. It differs from *K. cooperensis* (Swallow) in being larger and more transverse and seems to lack a dorsal median ridge although, as Girty (1929:

92) pointed out, that character cannot be confirmed in better-preserved calcareous specimens.

Material.—The illustrated specimens constitute the entire collection of this species.

Subfamily Toryniferinae Carter, 1994
Genus *Torynifer* Hall and Clarke, 1893
?*Torynifer* species
(Fig. 20A, B)

Description.—[This description is based on the specimen illustrated in Figure 20 plus a crushed ventral valve.] Medium-sized to large for the subfamily, transversely subovate in outline, subequally biconvex with proximate beaks; fold and sulcus moderately well delimited but weakly developed; cardinal extremities probably well rounded but poorly preserved in both specimens; ventral interarea low, concave, vertically striated, moderately narrow, apsacline; dorsal interarea not preserved; micro-ornament spinous but not well preserved; surfaces of both valves almost regularly rugose; ventral interior with short dental adminicula and very low median ridge; dorsal interior with either median ridge or septum, ascertainable only by destructive examination; other internal details unknown.

Comments.—Assignment to the genus *Torynifer* cannot be confirmed without additional information about the micro-ornament and dorsal interior. These Kenwood specimens are similar in size and outline to typical *Torynifer pseudolineatus* (Hall, 1858), from the upper Burlington and Keokuk limestones of the midcontinent, but differ in having more closely spaced, rugose growth lamellae.

Order Spiriferinida Ivanova, 1972
Suborder Spiriferinidina Ivanova, 1972
Superfamily Syrinothyridoidea Frederiks, 1926
Family Syringothyrididae Frederiks, 1926
Subfamily Permasyrinxinae Waterhouse, 1986
Genus *Pseudosyrinx* Weller, 1914
Pseudosyrinx cf. *P. missouriensis* Weller, 1914
(Fig. 21A–D)

1914 *Pseudosyrinx missouriensis* Weller: p. 406, pl. 65, fig. 5–9; pl. 66, fig. 11–13.

Diagnosis.—Medium-sized strongly transverse *Pseudosyrinx* with narrowly rounded cardinal extremities, rounded beak ridges, 16–18 costae on each flank, strongly procline, long, flattened ventral interarea, and long tongue in ventral sulcus.

Comments.—The specimen illustrated here differs from typical *Pseudosyrinx missouriensis* in having a shorter ventral interarea, a much shorter tongue in the sulcus, a proportionately longer dorsal valve, and shorter ventral valve with an even more strongly procline ventral interarea. An incomplete ventral valve provides no additional insight into the nature of this species, which may well represent an undescribed species.

Pseudosyrinx missouriensis Weller, 1914, is widely distributed in the lower Burlington Limestone, Meppen Formation, Fern Glen Formation, Pierson Formation, and St. Joe Formation, all from the midcontinent. It is readily differentiated from *Pseudosyrinx gigas* Weller, 1914, from the Keokuk Limestone, by its

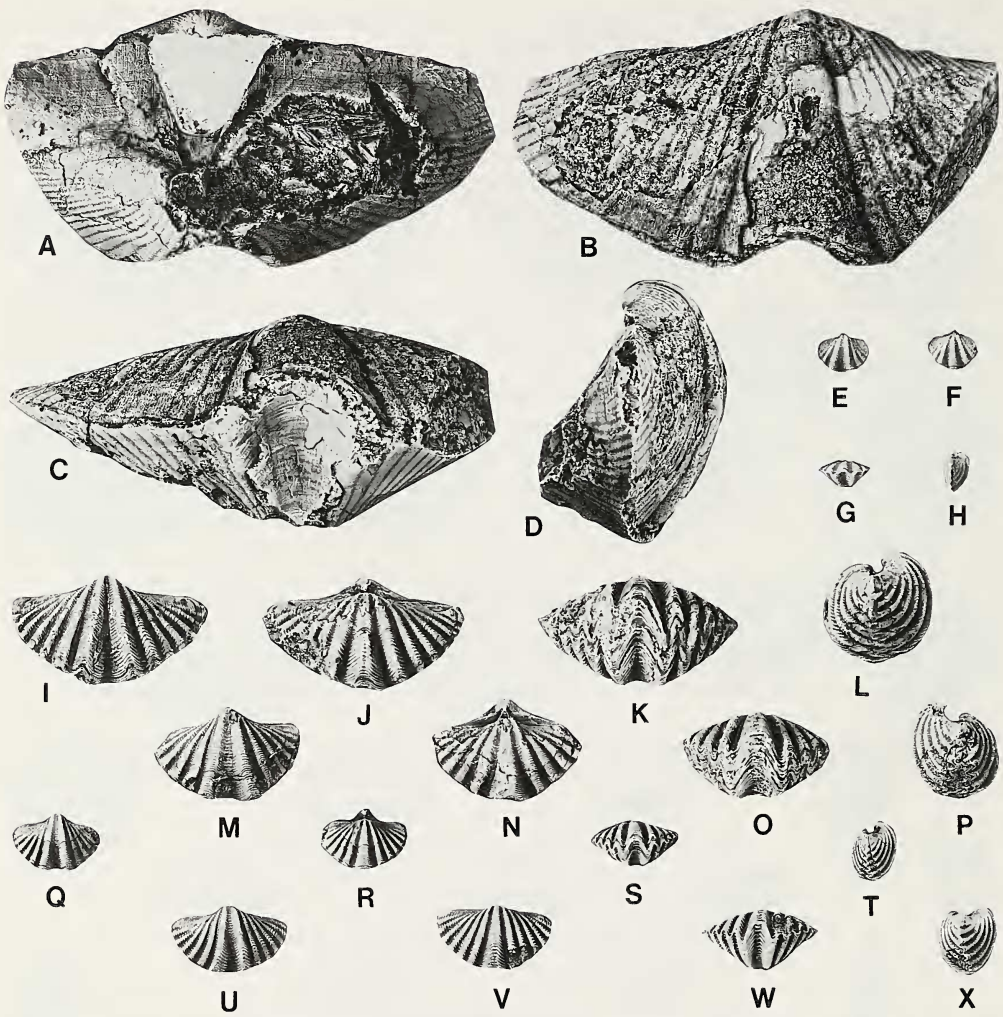


Fig. 21.—Punctate spiriferids. A–D, *Pseudosyrinx* cf. *P. missouriensis* Weller, ventral, dorsal, anterior, and lateral views, CM 45088. E–X, *Punctospirifer*? *subtexta* (White), ventral, dorsal, anterior, and lateral views of five specimens, CM 45089–45093. The specimens in Figures E–T bear a short spondylium, whereas the specimen in Figures U–X has discrete apical plates. All figures × 1.

rounded beak ridges, longer tongue, more strongly procline ventral interarea, and smaller size.

Superfamily Pennospiriferoidea Dagis, 1972
Family Punctospiriferidae Waterhouse, 1975
Genus *Punctospirifer* North, 1920

Type Species.—*Punctospirifer scabricosta* North, 1920, by original designation.

Diagnosis.—Small to medium size; outline variable, usually transverse; cardinal extremities subangular, rounded, or rarely slightly mucronate; fold-sulcus narrow to moderately wide, rounded, smooth or with single medial rib, often slightly

flaring anteriorly; ventral interarea moderately high, weakly concave, usually apsacline; lateral slopes with moderately numerous strong, rounded plicae separated by narrow subangular interspaces; growth varices irregularly spaced; micro-ornament of closely spaced imbricate growth laminae and fine, discontinuous capillae which rise and become wider with imbrications anteriorly as tiny U-shaped crenulations of lamellae in the type species and sometimes terminating in minute semi-erect pseudospines in others; dental adminicula short, slightly divergent; median septum long, high, slender; apical callus variably thick; ctenophoridium large, supported by short callus; dorsal adminicula absent or very short; adductors separated by long myophragm and bounded laterally in some species by low ridges; punctae moderately coarse; jugum probably absent.

Comments.—Recognition of this genus was problematical until the type species, *Punctospirifer scabricosta* North, 1920, was redescribed in great detail by Campbell (1959). In this paper the capillate micro-ornament was made known for the first time, however, the U-shaped minute crenulations forming pseudospinules or semi-erect nodes fringing the growth lamellae were described by Campbell (1959:353) as "extremely minute projections, causing an almost imperceptible serration of the lamellar edge." Campbell did not detect spines or spine bases per se.

The question then is—do the North American species with minute but distinct semi-erect pseudospinules fringing the growth lamellae, as described below, belong in the genus *Punctospirifer*? I think that they do because perfect and complete preservation of such delicate minuscule structures is bound to be rare. At least in North America representatives of this genus very rarely seem to be well preserved. In the unusually well-preserved specimens at hand any attempt to free the pseudospinules from the soft matrix for photographic purposes results in their destruction. They are best observed in finely silicified specimens, as occur in the white cherts of the lower Burlington Limestone, or in calcareous specimens preserved with a thin layer of soft marly matrix exposing the rows of pseudospinules, as occur in the Kenwood fauna.

Punctospirifer? *subtexta* (White, 1862)
(Fig. 21E–X, 22, 23)

1862 *Spiriferina*? *subtexta* White: p. 25.
1914 *Spiriferina subtexta* White: Weller, p. 291, pl. 36, fig. 35–40.

Diagnosis.—Small transverse punctospiriferids with smooth fold-sulcus, six to nine simple costae on each flank, sulcus bounded by disproportionately large costae, ventral interarea commonly flattened, weakly apsacline to almost catacline, dental adminicula and ventral septum converging and either discrete or forming short spondylium, and imbricate, discontinuously capillate growth lamellae fringed with moderately coarse, semi-erect pseudospinules.

Description.—Medium-sized for genus, subequally biconvex, transversely subelliptical to acutely subtrigonal in outline; greatest width just anterior to hingeline; lateral profile subovate to subcircular; cardinal extremities extended, acutely rounded in all growth stages, generally slightly compressed; fold-sulcus moderately well developed, narrow, rounded; flanks with six to nine, usually seven, rounded simple costae separated by equally wide interspaces in adult specimens, those bounding the ventral sulcus being disproportionately large; growth lamellae regularly imbricate; micro-ornament consisting of fine discontinuous capillae, rising anteriorly and terminating in fine semi-erect pseudospinules; shell substance moderately coarsely punctate.

Ventral valve strongly and almost evenly convex except at beak, slightly to moderately thicker than opposite valve; most convex in umbonal region; flanks moderately convex, sloping evenly to anterolateral margins; beak small, slightly laterally compressed, incurved; interarea moderately high, acutely

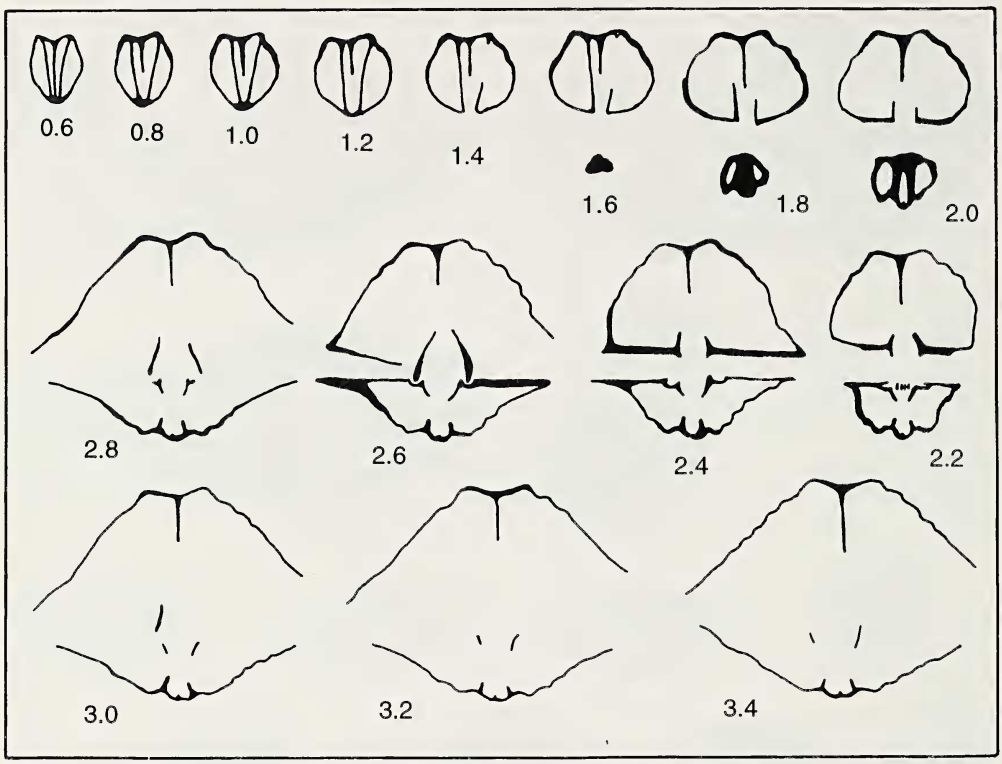


Fig. 22.—Transverse serial sections of *Punctospirifer*? *subtexta* (White) with discrete apical plates, CM 45094, × 3. Numbers refer to distance from ventral beak (in mm).

triangular, slightly concave, generally apsacline, rarely almost catacline; delthyrium much longer than wide; beak ridges acutely rounded to subangular; sulcus originating at beak, becoming gradually wider and deeper anteriorly, smooth and rounded except for imbricate ornament; interior with long, high median septum originating at beak, much shorter thin dental adminicula which converge in beak, fusing with septum in beak region to form short spondylium in some populations; teeth small, blade-like.

Dorsal valve moderately convex, most convex in umbonal region; lateral slopes evenly and weakly to moderately convex, sloping evenly to margins; ears as in opposite valve; dorsal interarea very short, orthocline to slightly anacline; fold low, smooth, rounded, rising above flanks only near anterior margin, defined by fold-bounding interspaces slightly deeper than those on lateral slopes; dorsum rounded or, in rare specimens, slightly flattened or marked by faint medial groove; interior with small ctenophoridium supported by short apical callus; muscle field well defined by prominently thickened bounding ridges on interior crests of fold-bounding interspaces; medial myophragm present in anterior portion of muscle field; sockets small, crural bases attached to mediodorsal edges of inner socket ridges; spiralia consisting of at least five whorls; presence or absence of jugum not ascertained.

Comments.—Tentative assignment to the genus *Punctospirifer* North is based on overall similarity to the type species. To my knowledge, a spondylium, albeit a very short one, has never been reported in this family. In fact, a spondylium is known from only two other genera in the suborder Spiriferinidina. For this reason the generic assignment is queried.

The collection on which this description is based consists of 25 complete specimens and several disarticulated valves but only a few have a well-preserved micro-ornament. Six of these specimens have discrete dental adminicula and median septa (Fig. 22), the remaining specimens having a short spondylium (Fig. 23A, B). No other morphological difference can be discerned between these groups of specimens, and, in light of their mutual occurrence within the Kenwood bioherm, it is assumed that those with a spondylium represent an unusual variant of the same species. Two of the illustrated specimens (Fig. 21E–T) have a spondylium whereas the other one (Fig. 21U–X) has discrete plates. Specimens of this species with a spondylium are also known from the Pierson Formation of Stone County, Missouri. The significance of the short spondylium (Fig. 23) is not known for it is an unusual, if not unknown, feature in members of this superfamily.

This is a moderately common species in the lower Burlington Limestone at Louisiana, Missouri, but seems to be less common elsewhere in the early Osagean. A capillate-fimbriate micro-ornament has not been previously observed or reported in this species.

Material.—In addition to the illustrated specimens there are 17 complete specimens and 12 disarticulated valves.

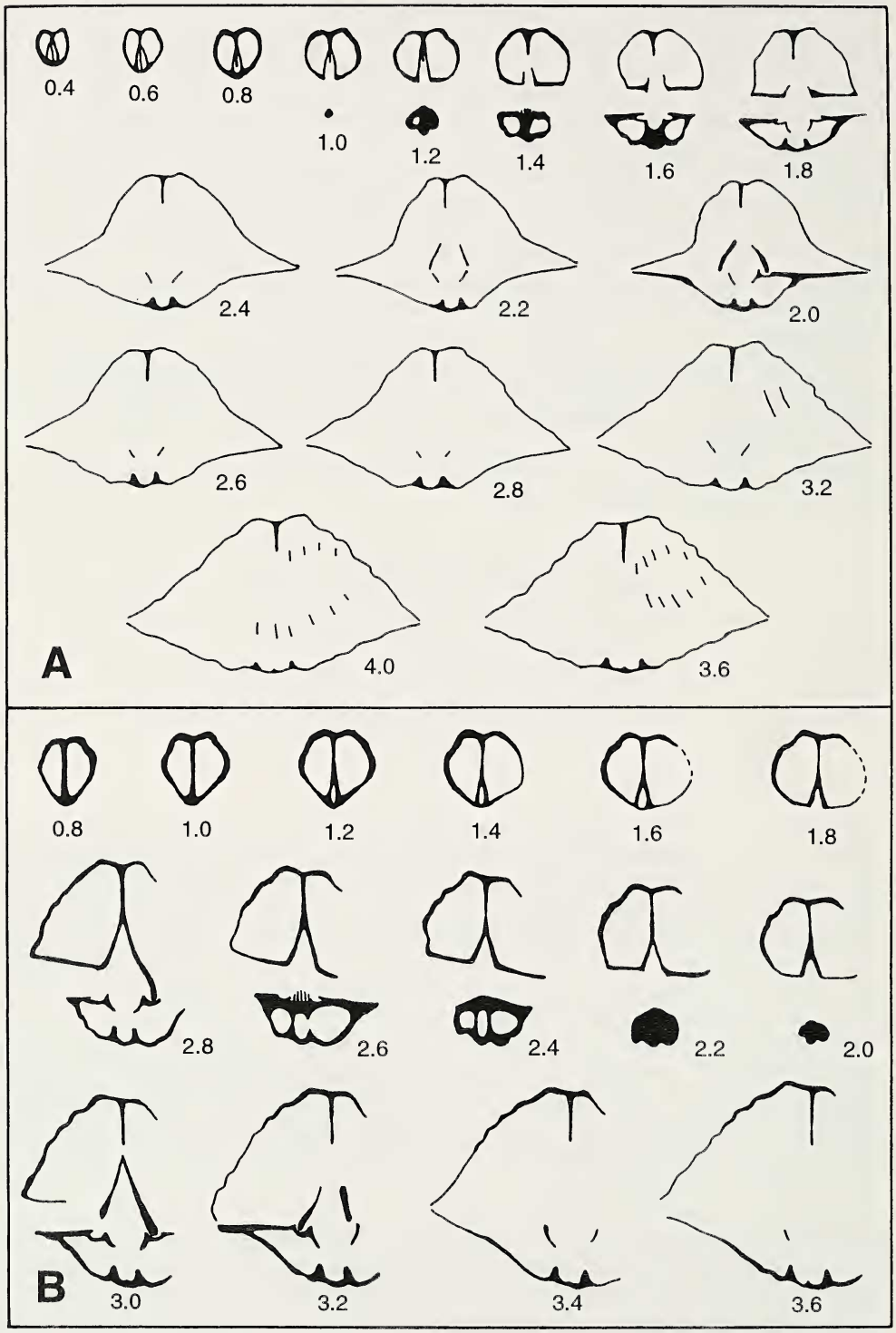
Order Terebratulida Waagen, 1883
Suborder Terebratulidina Waagen, 1883
Superfamily Dielasmatoidea Schuchert, 1913
Family Cranaenidae Cloud, 1942
Subfamily Cranaeninae Cloud, 1942
Genus *Cranaena* Hall and Clarke, 1893
Cranaena globosa Weller, 1914
(Fig. 24A–ff)

1914 *Cranaena globosa* Weller: 249, pl. 34, fig. 60–66; text-fig. 25.

Diagnosis.—Small elongate *Cranaena* with subovate rounded outline and thickly lenticular profile in adults, commonly with geniculate anterior margin of both valves in gerontic specimens; maximum width generally attained anterior to midlength in large adults; ventral beak erect or slightly incurved; venter and dorsum flattened anteriorly in large adults, forming straight or slightly emarginate anterior commissure; rarely with weak ventral sulcus; dental plates short; hinge-plate concave, dorsally situated; crural processes high, ventrally directed; loop short with posteriorly directed jugum.

Comments.—This species is moderately common in the lower Burlington white chert at Louisiana, Missouri, but has not been described from elsewhere in North America. Weller's (1914) holotype is purportedly from the "upper Burlington limestone" near Springfield, Missouri. A large, complete adult specimen was serially sectioned for this report (Fig. 25). Weller (1914) illustrated only the posterior portion of a dorsal valve.

Cranaena texana Carter, 1967, is similar to *C. globosa* Weller in outline, growth form, and general proportions but differs in being smaller with a less inflated lateral profile, the maximum width in large specimens is at midlength, the anterior portions of the valves are less flattened and thus lacking an emarginate anterior commissure in large adults. *Cranaena occidentalis* (Miller, 1892) from the Chouteau Limestone of Missouri is smaller and less inflated than *C. globosa* Weller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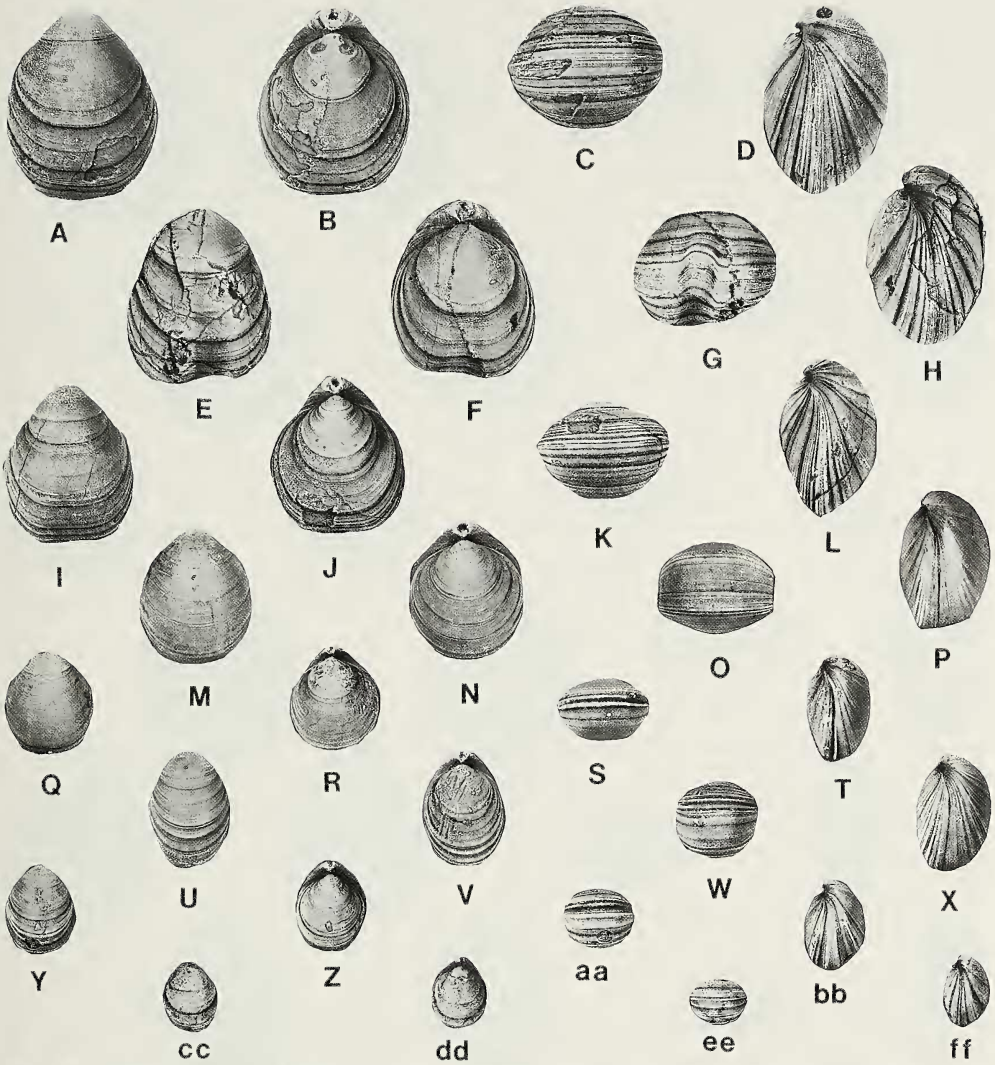


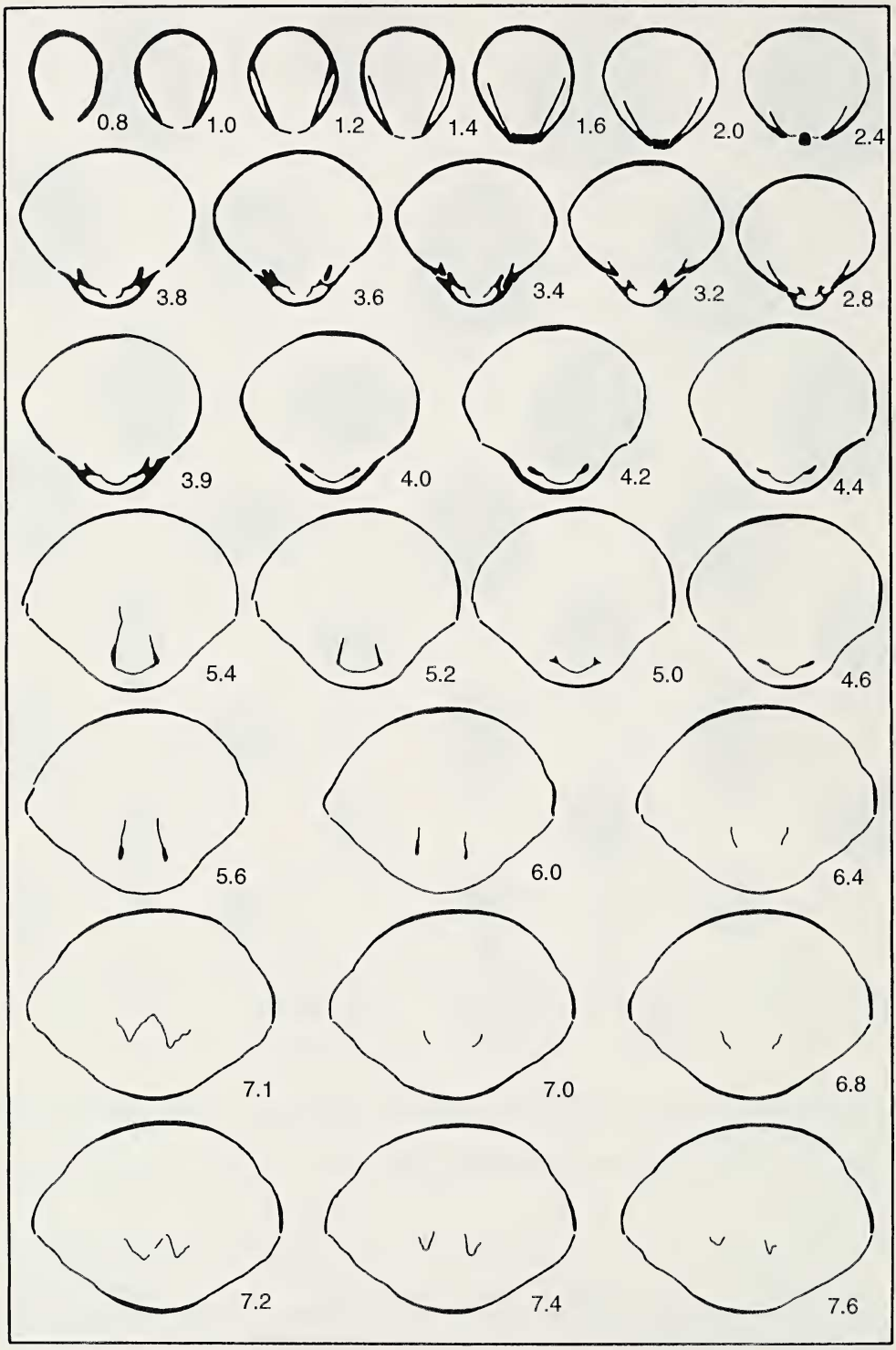
Fig. 24.—Terebratulids. A–ff, *Cranaena globosa* Weller, ventral, dorsal, anterior, and lateral views of eight specimens, CM 45097–45104, × 1.5.

and has nearly straight posterolateral margins, unlike the rounded posterior margins in the latter.

Material.—In addition to the illustrated specimens there are 269 complete specimens.

←

Fig. 23.—Transverse serial sections of two specimens of *Punctospirifer? subtexta* (White) with short spondylia. A, a small specimen, CM 45095; B, a larger specimen, CM 45096, both × 3. Numbers refer to distance from ventral beak (in mm).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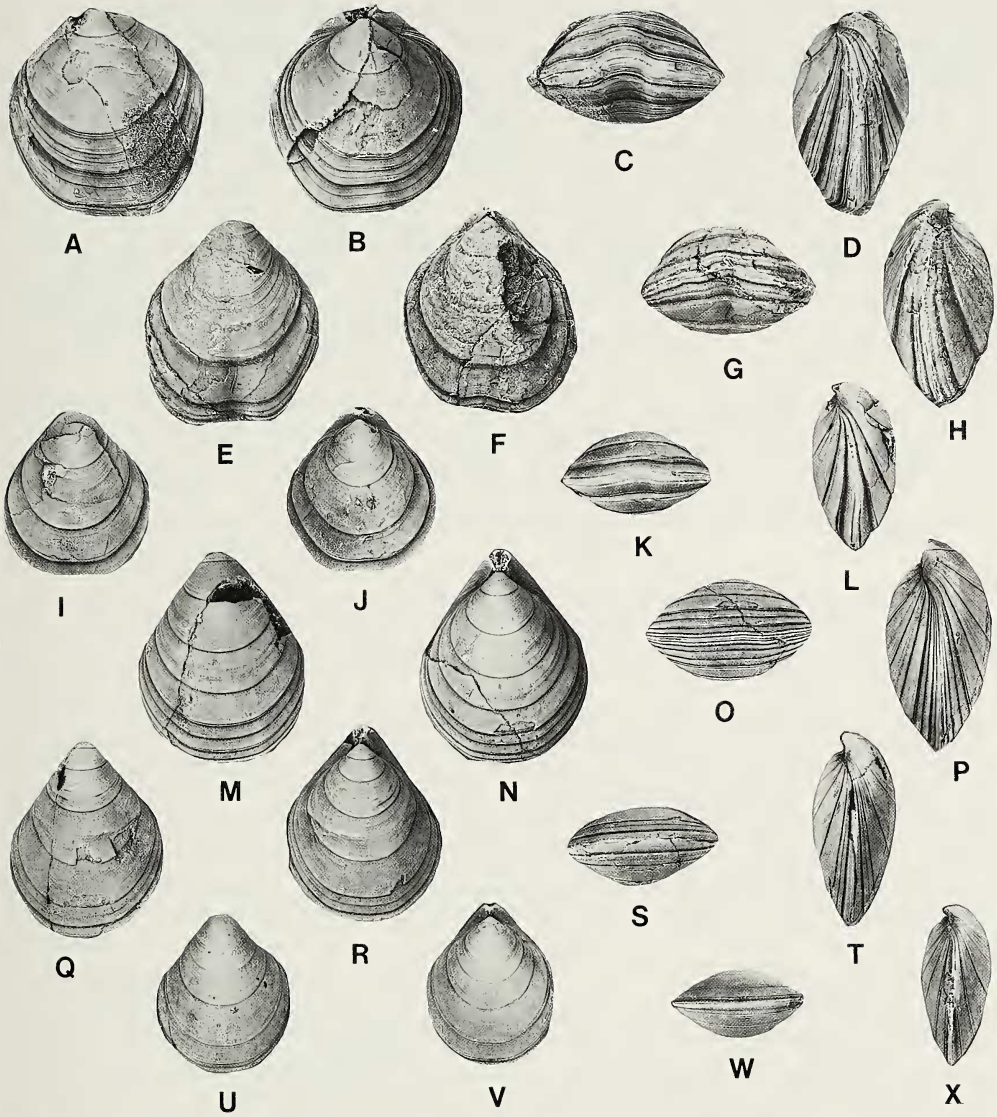

Fig. 26.—Terebratulids. A–L, *Dielasma oklahomensis* n. sp., ventral, dorsal, anterior, and lateral views of three specimens including the holotype (Fig. E–H, CM 450107) and two paratypes (CM 45106 and 45108), × 1. M–X, *Cranaena salinensis* n. sp., ventral, dorsal, anterior, and lateral views of three specimens, including the holotype (Fig. M–P, CM 45109) and two paratypes (CM 45110 and 45111), × 1.

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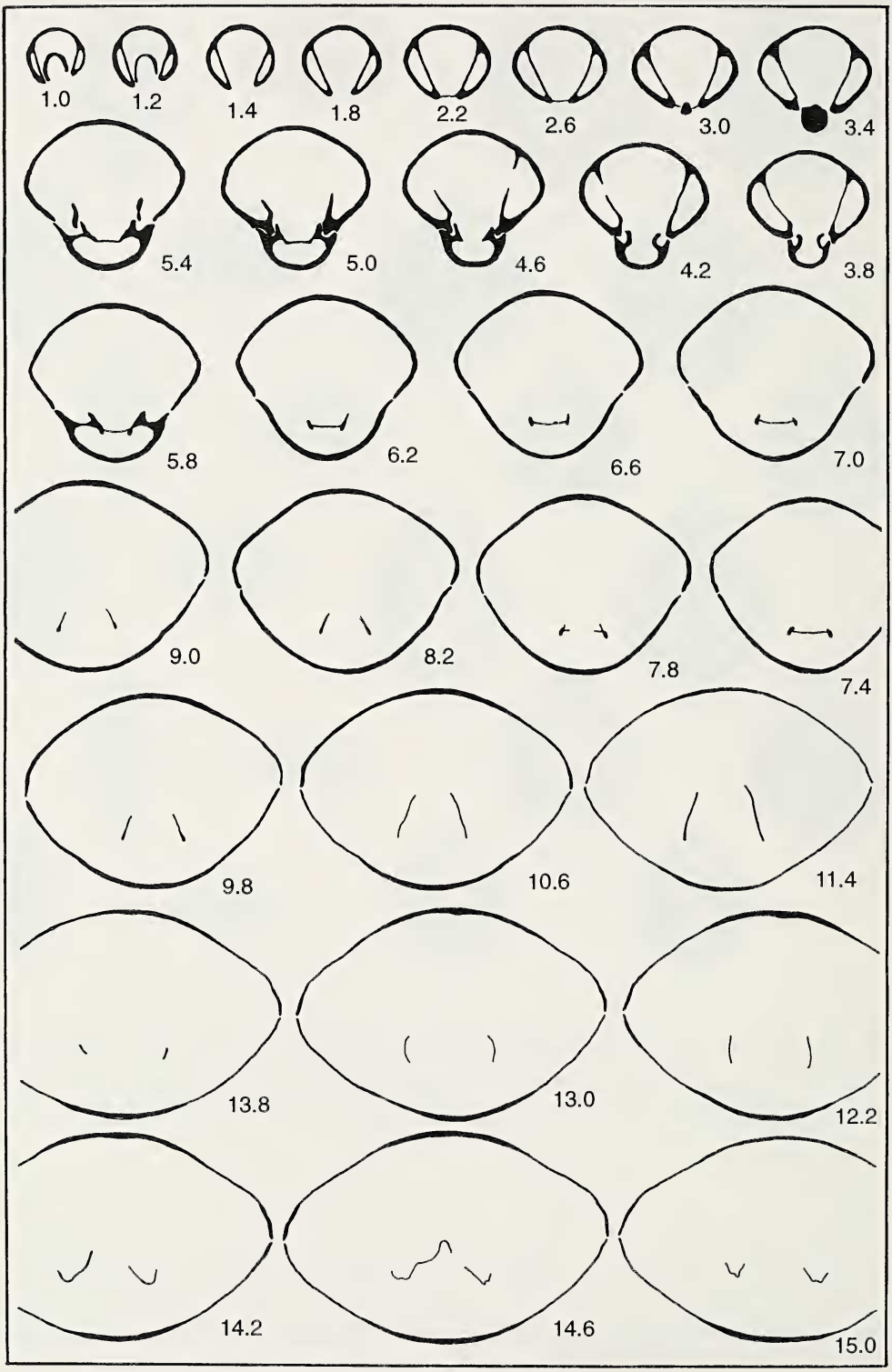
Fig. 25.—Transverse serial sections of *Cranaena globosa* Weller, CM 45105, × 3. Numbers refer to distance from ventral beak (in mm).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14.2
14.6
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Table 7.—*Measurements (in mm) of the types of* Cranaena salinensis, *n. sp.*

Number	Length	Width	Thickness
CM 45109	28.0	22.3	14.2
CM 45110	25.8	20.7	11.3
CM 45111	21.3	17.5	9.3

Cranaena salinensis, new species
(Fig. 26M–X; 27)

Holotype.—CM 45109, Fig. 26M–P.

Paratypes.—CM 45010 and 45011, Fig. 26Q–X.

Diagnosis.—Medium-sized, nearly equally biconvex, moderately well-inflated *Cranaena* having guttate outline with straight posterolateral margins, maximum width anterior to midlength in large adults, rounded dorsum and venter with rectimarginate anterior commissure, and suberect beak angle; internally with well-developed, moderately long dental plates; hingeplate slightly concave anteriorly, nearly flat posteriorly, loop long.

Description.—Medium size for genus, subequally biconvex, longitudinally guttate in outline in adults, subovate to subelliptical in juveniles; greatest width attained anterior to midlength in adults, near midlength in juveniles; anterior profile lenticular; lateral profile lenticular to subguttate; fold and sulcus absent, both valves nearly evenly convex; anterior commissure rectimarginate; growth varices strong, widely spaced.

Ventral valve evenly convex in lateral profile or slightly more convex umbonally; lateral slopes weakly convex, venter more convex, arched; beak suberect, rarely erect; foramen ovate, permesothyridid, slightly labiate; beak ridges narrowly rounded, forming poorly defined, moderately concave palintropes; interior with pedicle collar and moderately long, diverging dental plates; teeth small.

Dorsal valve about as thick as opposite valve, evenly convex in lateral profile or slightly more convex posteriorly near umbo; lateral slopes weakly and evenly convex, dorsum more convex, arched as in opposite valve; interior with apically perforated, weakly concave or flattened hingeplate; crura attached to dorsal edges of inner socket ridges; crural processes strongly developed, projecting ventrally into body cavity; loop moderately long for genus; jugum ventrally arched and directed slightly posteriorly.

Measurements of Types.—See Table 7.

Comments.—This new species is most similar in size, outline, and dorsal interior to the species described as *Cranaena* cf. *C. hannibalensis* Moore, 1928, by Carter (1967) from the Chappel Limestone of central Texas. This Chappel species differs in being smaller, with a subovate to nearly circular outline and with the maximum width attained at midlength. *Cranaena hannibalensis* Moore, 1928, was described from the Hannibal Formation (middle Kinderhookian) of Pike County, Missouri, and Moore's types are not very similar to this new species, being smaller and less elongated, with a subovate outline and maximum width at midlength. In addition, the dorsum is flattened in some specimens. Unfortunately, the dorsal interior is unknown.

Material.—In addition to the illustrated types there are 23 articulated specimens and four disarticulated valves.

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Fig. 27.—Transverse serial section of *Cranaena salinensis* n. sp., CM 45112, × 2. Numbers refer to distance from ventral beak (in mm).

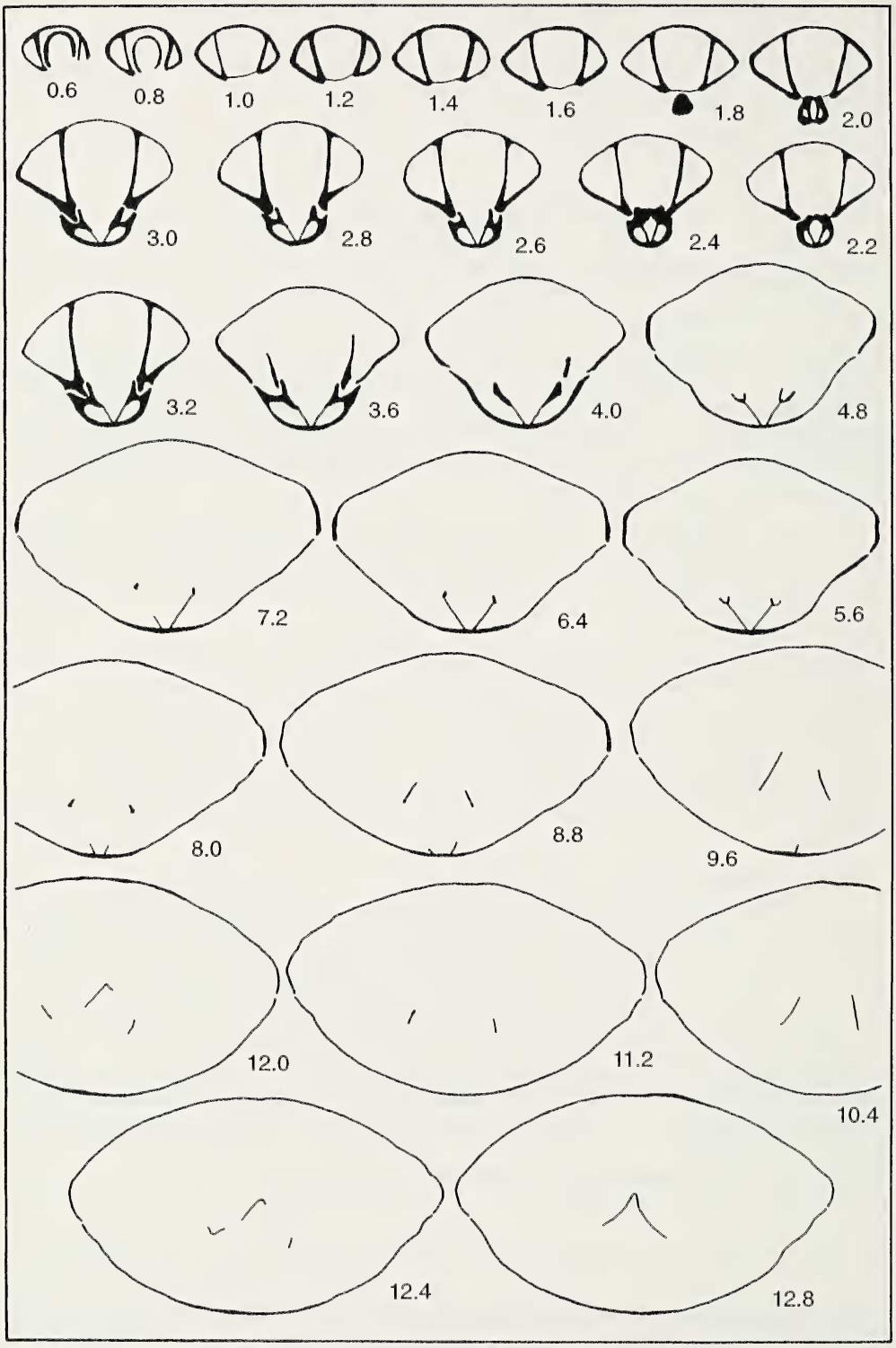
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Table 8.—*Measurements (in mm) of the types of* Dielasma oklahomensis, *n. sp.*

Number	Length	Width	Thickness
CM 45106	+27.8	26.4	15.9
CM 45107	27.4	23.0	14.9
CM 45108	22.1	19.7	11.5

Family Dielasmatidae Schuchert, 1913
Subfamily Dielasmatinae Schuchert, 1913
Genus *Dielasma* King, 1859
Dielasma oklahomensis, **new species**
(Fig. 26A–L; 28)

Holotype.—CM 45107, Fig. 26E–H.

Paratypes.—CM 45106 and 45108, Fig. 26A–D, 26I–L.

Diagnosis.—Large, moderately elongate, subequally biconvex *Dielasma* with subpentagonal outline; narrow, shallow sulcus in ventral valve; and very weakly uniplicate anterior commissure.

Description.—Medium to large for genus, subequally biconvex, longitudinally subpentagonal in outline; greatest width and thickness near or posterior to midlength; anterior profile dorsibiconvex, lateral profile subequally lenticular; anterior commissure weakly uniplicate; fold absent or very weakly developed and narrow anteriorly, scarcely detectable; shallow, narrow sulcus present in anterior third or half of large specimens only, forming truncated front margin or slight emargination; growth varices strong on anterior half of shell, irregularly spaced; growth lines finely and regularly spaced; fine punctae densely arranged in quincunx.

Ventral valve moderately and evenly convex, most convex in umbo; posterolateral margins nearly straight; venter slightly arched posteriorly, with shallow, narrow sulcus in anterior half or third of shell; lateral slopes weakly convex; umbo broad, generally subtending an angle slightly greater than 90° in large specimens; beak ridges narrowly rounded, extending anteriorly and defining broad weakly concave palintropes; beak small, suberect; foramen subovate, moderately labiate, epithyrid; deltidium flattened or slightly convex; interior with pedicle collar and short dental plates, diverging slightly both anteriorly and laterally; teeth delicate, bladelike.

Dorsal valve slightly thicker than opposite valve, almost evenly convex in lateral profile, medially arched in anterior profile; lateral slopes moderately convex; most convex in slightly inflated umbonal region which is well defined by anterolateral concave flexures; beak small, protruding into delthyrium; fold generally absent, rarely present as weak, low prominence near anterior margin; interior with inner hingeplates nearly joining at floor of valve, diverging moderately anteriorly; crural bases originating at dorsal edges of inner socket ridges, attached to ventral edges of inner hinge plates and extending forward as rounded rods; crural processes moderately high converging ventrally; jugum projecting anteriorly.

Measurements of Types.—See Table 8.

Comments.—This new species is not similar to other Lower Mississippian *Dielasma* in North America. *Dielasma* is rare in the Lower Carboniferous of North America, there being documented occurrences noted only by Carter (1967, 1987) and Rodriguez and Gutschick (1968), the latter being tentatively referred to *Terebratula utah* Hall and Whitfield, 1877, which is unknown internally. The other

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Fig. 28.—Transverse serial sections of *Dielasma oklahomensis* n. sp., CM 45113, × 2. Numbers refer to distance from ventral beak (in mm).

descriptions by Carter (1967, 1987) were inadequate for species assignment but the interiors and generic assignment were ascertained by means of serial sections.

Material.—In addition to the types there are five articulated specimens.

ACKNOWLEDGMENTS

The fieldwork for this report was supported by the M. Graham Netting Research Fund of the Carnegie Museum of Natural History and a grant from the Amoco Production Company. Albert Kollar provided valuable field assistance for which I am grateful.

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